



**FINAL**

**ACTION PLAN FOR THE  
CAMP EDWARDS IMPACT AREA  
GROUNDWATER QUALITY STUDY**

**MASSACHUSETTS MILITARY RESERVATION  
CAPE COD, MASSACHUSETTS**

**Volume II - Appendices A-C**

**Prepared for**

**NATIONAL GUARD BUREAU  
ARLINGTON, VIRGINIA**

**pursuant to**

**THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, REGION I  
Administrative Order SDWA I-97-1019**

**Prepared by**

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**July 1997**



## **APPENDIX-A**

### **Quality Assurance Quality Control Project Plan**





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CAMP EDWARDS IMPACT AREA  
GROUNDWATER QUALITY STUDY**

**APPENDIX A  
QUALITY ASSURANCE / QUALITY CONTROL PLAN**

**MASSACHUSETTS MILITARY RESERVATION  
CAPE COD, MASSACHUSETTS**

**Prepared for**

**NATIONAL GUARD BUREAU  
ARLINGTON, VIRGINIA**

**Prepared by**

**OGDEN ENVIRONMENTAL AND ENERGY SERVICES  
ENGINEERING TECHNOLOGIES ASSOCIATES, INC.**

**July 1997**



## **1.0 PROJECT DESCRIPTION**

### **1.1 Introduction**

The Massachusetts Military Reservation (MMR) is located on upper Cape Cod, about 60 miles south east of Boston. Approximately 14,000 acres of this 22,000 acre facility, referred to as the range, maneuver and impact area, has been, and is still used for military and law enforcement training. The range and impact areas are being considered for the development of municipal water supplies. This investigation of the range and impact areas is designed to determine if there is any ground water quality impairment resulting from the training activities in the areas.

This Quality Assurance/Quality Control (QA/QC) plan serves as a controlling mechanism during the investigation to ensure that all data collected are valid, reliable and defensible. This document outlines the objectives, organization, and QA/QC activities to be undertaken in order to achieve the desired goals. This QA/QC plan is being prepared as an addendum to the generic QA/QC plan for conducting environmental investigations at MMR, and according to the Environmental Protection Agency's (EPA) guidelines and specifications for preparing quality assurance plans, EPA-600/483-004.

### **1.2 Site Description and History**

The range and impact areas occupy about 14,000 acres in the north-central portion of MMR. This facility consists of a centrally located impact area used for heavy mortar and artillery training; and numerous firing ranges, gun and mortar positions and training areas surrounding the impact area.

For over 40 years, the range and impact area has been used for firing of small arms, guns, heavy artillery, and ordnance demolition. The spent shells and byproducts of the used munitions can cause environmental impairment, and subsequently result in environmental degradation of the soils and groundwater.

### **1.3 Target Compounds**

Previous investigations have detected low levels of some pesticides, explosives and heavy metals in the soils. Table 1 shows a list of contaminants detected at the site by previous investigations, and how their levels compare with EPA risk-based screening concentration for industrial soils (EPA Screening Guidance, July 1996). For some of the heavy metals, risk-based screening levels were slightly exceeded. The lead levels are also higher than the 400mg/kg suggested by EPA.

### **1.4 Project Objectives**

The objectives of the field program are to obtain the data and information to evaluate the quality of ground water beneath the range and impact areas. To obtain the necessary data, a sampling program to collect and analyze samples from various environmental media is being proposed.

Upon completion of the field program, the data obtained will be used to support a preliminary risk evaluation, and also to determine whether additional investigations are warranted.

### **1.5 Data Quality Objectives**

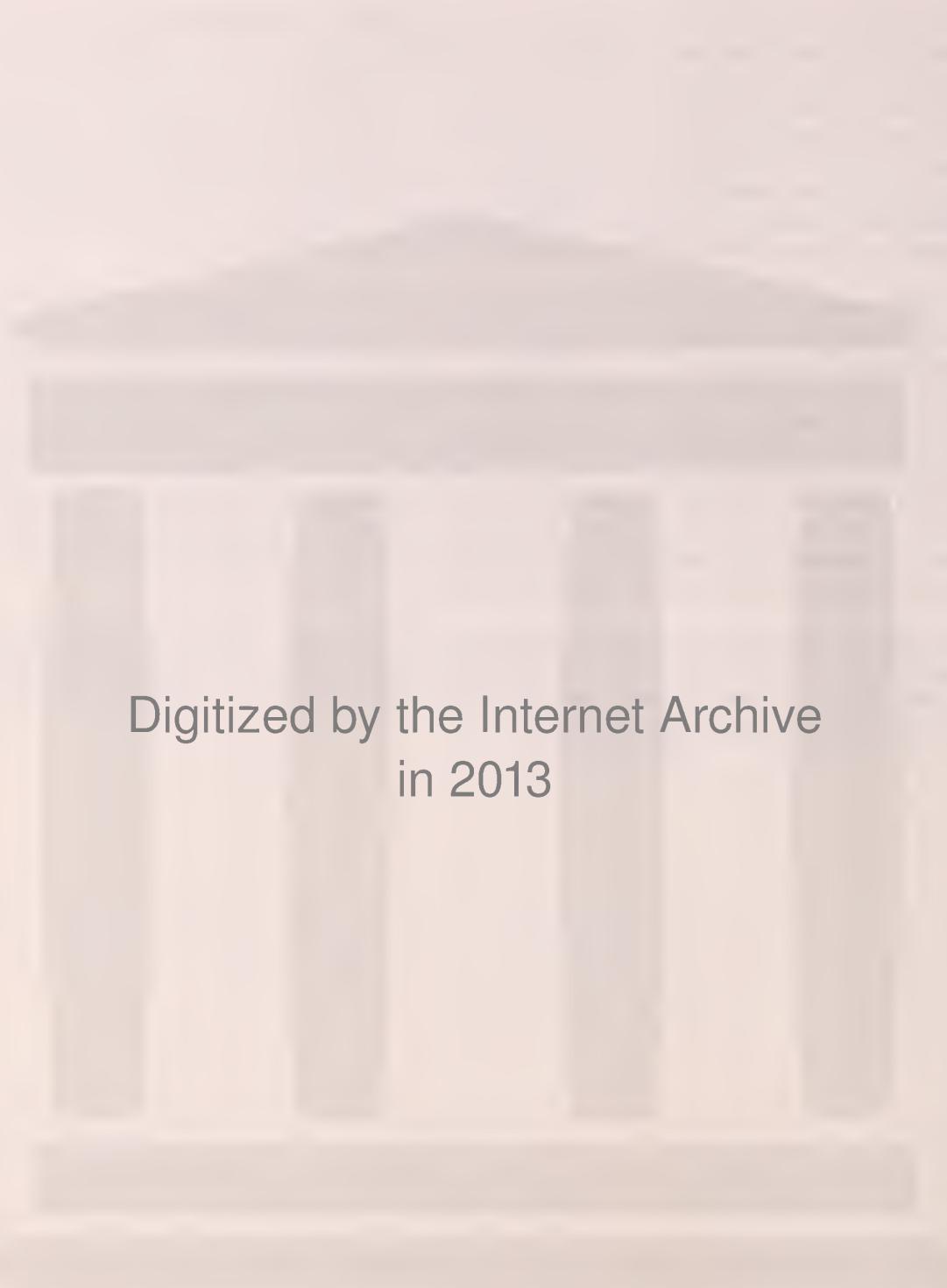
Samples collected will be analyzed for Explosive Compounds (Explosives), Target Compound List Volatile Organics (TCL VOCs), TCL Semivolatiles (TCL SVOCs), TCL Pesticides and PCBs (Pesticides/PCBs), and Target Analyte List Inorganics (TCL Metals/CN) using CLP methods where available, and for explosives using Test Methods for Evaluating Solid Waste, SW-846 Method 8330, Method 8515 and the Cold Regions Research and Engineering Laboratory, (CRREL) colorimetric method



to measure RDX. Herbicides will be analyzed for using Test Methods for Evaluating Solid Waste, SW-846 Method 8151. Groundwater quality parameters of phosphorous, nitrate, nitrite and ammonia will be measured in soil and water samples by Standard Methods for the Examination of Water and Wastewater, 17th Edition, Method 4500-PB(3) 4500-P,E, for phosphorous, Test Methods for Evaluating Solid Waste, SW-846 Method 9056 for Nitrate and Nitrite and Standard Methods for the Examination of Water and Wastewater, 17th Edition, Method 4500-N,B 4500-NH3F for ammonia. EDB will be analyzed by EPA Method 504.1 in water samples and by SW-846 Method 8021 in soil samples. MTBE will be measured by Test Methods for Evaluating Solid Waste, SW-846 Method 8021. Other methods may be utilized as long as the laboratory demonstrates the ability to meet the stated data quality objectives.

Data will be independently validated according to the USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, (USEPA, Feb. 1994), the USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, (USEPA, Feb. 1994), Region I EPA, New England Data Validation Guidelines for Evaluation of Environmental Analyses, (EPA Region I, Dec. 1996), Region I Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses, (EPA Region I, Feb. 1989), or for analyses performed using non-CLP methods, the Ogden Environmental and Energy Services Data Validation Procedures. An EPA Region I Tier III validation will be performed upon 10% of the data. The remaining 90% of the data will be reviewed at EPA Region I Tier II with the exception of the CRREL explosive analyses which will be evaluated at a modified EPA Region I Tier I. Should any validation review indicate data deficiencies, an additional portion of the data will be fully reviewed to determine the extent of the deficiencies and the affect on overall usability.

Record keeping, field activities, sampling, sample custody, laboratory analyses, data reduction and validation must be of sufficient scope and detail that the resulting data are technically and legally defensible. This QA/QC plan prepared to outline the specific requirements for conducting all activities on this project to ensure that those objectives are met.



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TABLE 1-1. List of Suspected Contaminants

| Parameter              | Maximum Amount Detected mg/kg | EPA Generic Soil Screening Levels I mg/kg | OSHA PEL/ACGIH TLVs mg/m <sup>3</sup> |
|------------------------|-------------------------------|---|---------------------------------------|
| hexachlorobenzene      | .6                            | 2   | NE / 0.025 skin, Ca                   |
| diethylphthalate       | 14                            | 470                                       | 5.0 / 5.0                             |
| N-Nitrosodiphenylamine | 0.38                          | 1   | NE / NE                               |
| 2,4-DNT                | 0.71                          | 0.0008                                    | 1.5 skin / 0.15 skin                  |
| <b>PESTICIDES</b>      |                               |   |                                       |
| DDE                    | 0.005                         | 54  | 1.0 ca / 1.0 Ca                       |
| DDD                    | 0.130                         | 16  | 1.0 ca / 1.0 Ca                       |
| endrin ketone          | 0.0360                        | 1   | 0.1 skin / 0.1 skin                   |
| endosulfan sulfate     | 0.009                         | 18  | 0.1 skin / 0.1 skin                   |
| alpha chlordane        | 0.009                         | 10  | 0.5 skin / 0.5 skin, Ca               |
| gamma chlordane        | 0.010                         | 10  | 0.5 skin / 0.5 skin, Ca               |
| <b>EXPLOSIVES</b>      |                               |   |                                       |
| HMX                    | 2.713                         |   | NE / NE                               |
| TNT                    |                               |   | 1.5 skin / 0.5 skin                   |
| RDX                    | 0.009                         | 100(furan)                                | NE / NE                               |
| Dioxins and Furans     |                               |   |                                       |
| <b>HERBICIDES</b>      | 0.029                         |   | NE / NE                               |
| dinoseb                | 232                           |   | NE / NE                               |
| MCPP                   |                               |   |                                       |
| <b>INORGANICS</b>      | 26100                         |   | 15 / 10                               |
| aluminum               | 30.8                          | 38  | 1.0 / 0.5                             |
| chromium (total)       | 156                           |   | 1.0 / 1.0                             |
| copper                 | 22700                         |   | 5 / 5                                 |
| iron                   | 1830                          | 400                                       | 0.05 / 0.05 Ca                        |
| lead                   | 12200                         |   | 15 / 10                               |
| magnesium              | 188                           |   | 5 cel / 0.2                           |
| manganese              | 0.36                          | 2   | 0.1 cel / 0.01                        |
| mercury                | 22.9                          | 6000                                      | 0.5 cel / 0.05                        |
| vanadium               | 15.7                          | 130                                       | 0.015 / 0.1                           |
| nickel                 | 4.7                           | 29  | 0.5 / 0.01 Ca                         |
| arsenic                | 26000                         | 1600                                      | 0.5 / 0.5                             |
| barium                 | 1.2                           | 63  | 0.005 Ca / 0.002 Ca                   |
| beryllium              | 4.5                           | 8   | 0.005 Ca / 0.002 Ca                   |
| cadmium                | 1480                          |   | 5.0 / 2.0                             |
| calcium                | 1200                          |   | NE / NE                               |
| potassium              | 5.9                           | 34  | 0.01 / 0.01                           |
| silver                 | 180                           | 12000                                     | 15 / 10                               |
| zinc                   |                               |   |                                       |

1. From EPA, July 1996, Soil Screening Guidance Technical Background Document Appendix A.

Skin = prevent skin contact.

Ca = Carcinogen.

Cel = Ceiling level

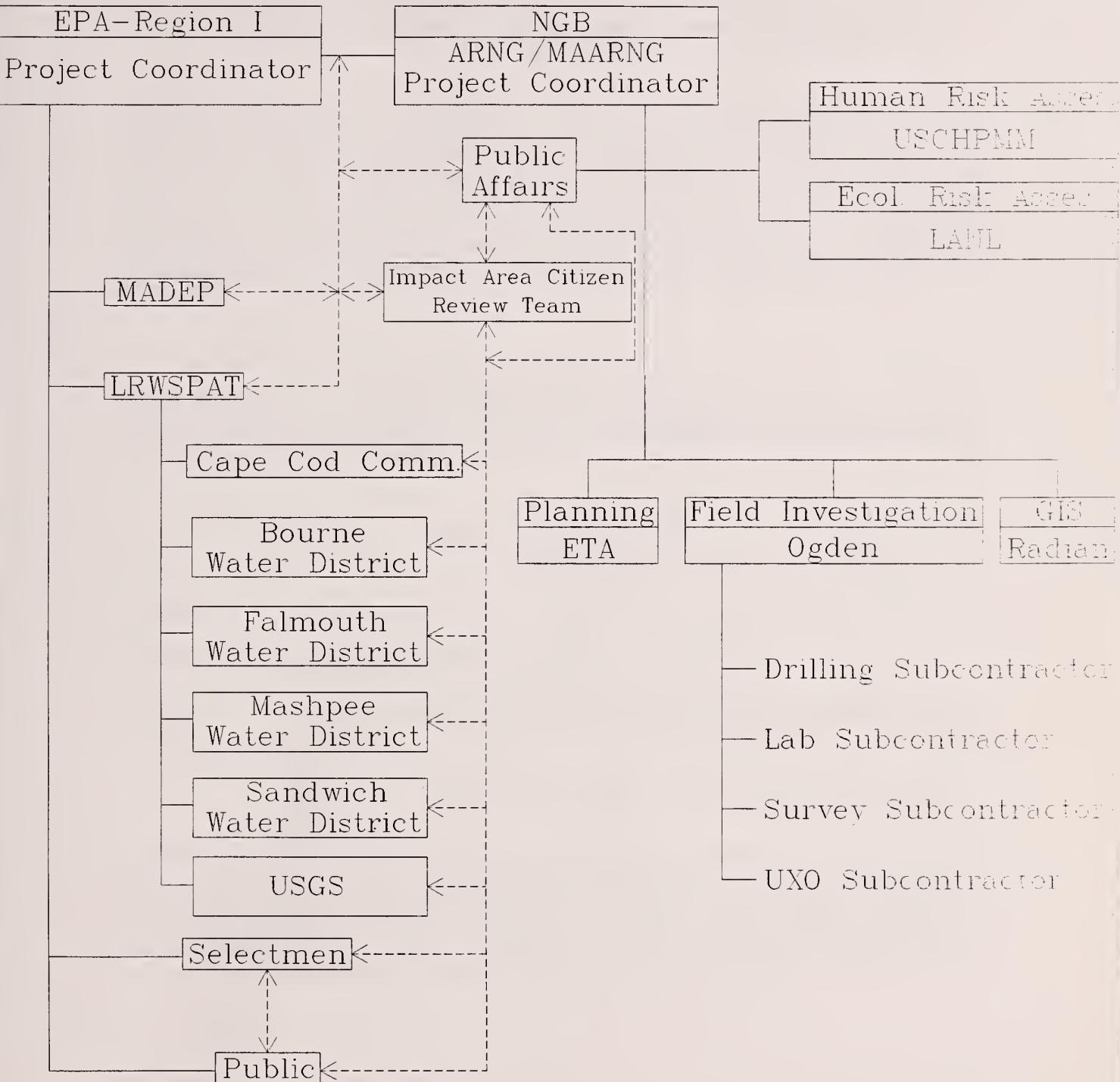
NE = None established



## 2.0 PROJECT ORGANIZATION

The Camp Edwards Impact Area Groundwater Quality Study is being performed in accordance with an Administrative Order issued to the National Guard Bureau (NGB) by USEPA Region I under the Safe Drinking Water Act. The NGB Project Coordinator will administer all actions under the terms of this Order, in coordination with USEPA's Technical Project Coordinator. A chart showing the relationship between NGB, USEPA, and other entities is provided in Figure 2-1. NGB subcontractors for the field investigation activities will be selected as indicated in the project schedule contained in the Workplan.







### 3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA IN TERMS OF PRECISION, ACCURACY, COMPLETENESS, REPRESENTATIVENESS, AND COMPARABILITY

The quality assurance objective for all measurement data include considerations for precision, accuracy, completeness, representativeness, and comparability. This section incorporates, by reference, portions of the USEPA Contract Laboratory Program (CLP) protocols. For organic parameters, the protocols are found in the Statement of Work (SOW) OLMO3.2 and for low level water analyses the Statement of Work (SOW) OLC02.1. For inorganic parameters, the protocols are found in the Statement of Work (SOW) ILMO4.0. Furthermore, parts of this section also incorporate by reference portions of the EPA 600 Series Methods of Chemical Analysis of Water and Wastes, revised March 1993, Standard Methods for the Examination of Water and Wastewater, 17th Edition 1989 and Test Methods for Evaluating Solid Wastes, SW-846, 3rd Revision, 1986.

#### 3.1 Precision

Precision is a quantitative measure of the variability between two duplicate samples. Precision is expressed as the relative percent difference (RPD) in concentration between duplicate and original sample analyses, as calculated from the following formula:

$$RPD = \frac{|S - D|}{\frac{1}{2}(S + D)} \times 100$$

where:

RPD = Relative percent difference (percent);  
S = Concentration of analyte in first (original) sample or spiked sample (mg/kg or  $\mu\text{g/l}$ ); and  
D = Concentration of analyte in second (duplicate) sample or spiked sample (mg/kg or  $\mu\text{g/l}$ ).

The precision of the analytical data is evaluated by calculating RPD values for four types of duplicate samples: field duplicates, MSDs, laboratory duplicates, and blank spike duplicates. For each type of duplicate sample, all RPD values for a given analyte are averaged to produce a single, analyte-specific average RPD value which is then compared against an established QC criterion. The QC criterion are method or laboratory specific QC criterion. Data qualifiers may be applied in the data validation process to certain analytical results where RPD values do not meet the established QC criteria.

#### 3.2 Accuracy

Spike sample analyses are conducted by the laboratory to assess the accuracy of specific analytical methods and to provide information on the effect of the sample matrix on the analytical methodology. Spike sample analyses are performed by adding known amounts ("spikes") of representative target compounds to a sample aliquot that is subjected to the entire analytical procedure. The original sample (non-fortified) and the spike sample results are compared. Accuracy is reported as percent recovery (%R) of the spike, as calculated from the following equation:



$$\%R = \frac{SSR - SR}{SA} \times 100$$

where:

%R = Percent recovery (percent);

SSR = Spike sample result (concentration units);

SR = Original sample result (concentration units); and

SA = Spike added (concentration units).

The accuracy of the analytical data is evaluated by calculating %R values for two types of spike samples: MS samples and blank spike samples. For each type of spike sample, all %R values for a given analyte are averaged to produce a single, analyte-specific average %R value which is then compared against an established QC criterion. QC criterion may be method or laboratory specific QC criterion. Data qualifiers may be applied in the data validation process to certain analytical results where the %R values do not meet the established QC criteria.

### **3.3 Representativeness**

Representativeness expresses the extent to which the analytical data reflect the actual media at the site. In general, the data are representative of the site conditions and characteristics. Acceptable representativeness is achieved by proper sampling and sample management procedures as documented in Section 4.0. Representativeness will be evaluated with respect to general sample management issues including sample documentation, preservation, handling, and transport as well as a discussion of representativeness with respect to analytical-method specific issues including method deviations, presence of potential laboratory or field artifacts, indications of sample nonhomogeneity, internal standard recovery deficiencies, and surrogate recovery deficiencies. The evaluation of the individual method specific representativeness does not supersede the sampling design assurance of representativeness with respect to site conditions and geochemical characteristics.

### **3.4 Comparability**

Comparability is a qualitative parameter that expresses the confidence with which one data set can be compared to another. Comparability of the sampling and analytical programs are evaluated separately.

Sampling comparability will be evaluated based upon the following:

- A consistent approach to sampling was applied throughout the program;
- Samples were consistently preserved; and
- Sampling was performed during the same time of the year and under similar physical conditions.

Analytical comparability will be evaluated based upon the following:

- The investigation consistently utilized the same analytical laboratory, sample preparation routine, and analytical methods;



- The analytical results for a given analysis were reported with consistent detection limits and consistent units of measure; and
- Soil sample results were reported on a dry weight basis, allowing for comparison between different samples and with Soil Screening Levels (SSLs).



### 3.5 Completeness

Completeness is a measure of the amount of usable data resulting from the sampling and analysis program. Completeness of the sampling and analytical programs are evaluated separately.

Sampling completeness is generally defined as the number of samples collected divided by the number of samples required to adequately assess Site conditions. The sampling completeness objectives are 90 percent.

Analytical completeness is defined as the percentage of acceptable (i.e., not rejected) data points. Analytical completeness is calculated on a method basis with the exception of Method ILM04.0 (metals); for this method, analytical completeness is calculated on an individual analyte basis. The completeness objective for the analytical program is 90 percent.



#### **4.0 SAMPLING PROCEDURES**

Sampling procedures have been developed to collect representative data and to guide future remediation. Sample collection methods are detailed in Section 4.0 of the work plan and in the Field Sampling Plan attachments to the work plan. All decontamination procedures, well development, purging, sample collection, and sample preservation will be conducted in accordance with the Standard Operating Procedures and protocols in the work plan.



## 5.0 SAMPLE CUSTODY

The sample custody and documentation procedures described in this section will be followed during sample collection. Each person involved with sample handling will be trained in chain-of-custody procedures prior to the implementation of the field program. To reduce the chance for error, the number of personnel handling the samples will be restricted.

All samples will be accompanied by a complete Chain-of-Custody (COC) Record, an example of which is shown in Figure 5-1. A COC seal, an example of which is shown in Figure 5-2, will be fixed on each shipping container so that it cannot be opened without breaking the seal. A COC Record will accompany the sample during shipment to the laboratory and during analysis. If samples are split and sent to different laboratories, a copy of the COC Record will accompany each split sample. When transferring samples, the individuals relinquishing and receiving the samples will sign, date, and note the time.

The original copy of the COC Record will accompany the samples to the laboratory. The laboratory will maintain one file copy, and the completed original will be returned to the Project Manager as a part of the final analytical report. This record will be used to document sample custody transfer from the sampler to the laboratory.

### 5.1 Sample Custody

A sample is under custody if:

- It is in the actual possession of the Field Sample Custodian (FSC); or
- It is in view of the FSC, after being in the physical possession of the FSC; or
- It was in physical possession and then locked up by the FSC to prevent tampering; or
- It is in a designated and identified secure area.

### 5.2 Sample Custody in the Field

The following procedures will be used to document, establish, and maintain custody of field samples:

- Sample labels will be completed for each sample, using black, waterproof ink, ensuring that the labels are legible and affixed firmly to the sample container.
- All sample-related information will be recorded in the project logbooks.
- The FSC will retain the custody of the samples until they are transferred or properly dispatched.
- During the course and at the end of the field work, the Field Supervisor will determine whether these procedures have been followed, and if additional samples are required.







| CUSTODY SEAL             |                |
|--------------------------|----------------|
| Person Collecting Sample | Sample No.     |
| (Signature)              |                |
| Date Collected           | Time Collected |
| .....                    |                |
| .....                    |                |
| .....                    |                |

FIGURE 5-2 CUSTODY SEAL EXAMPLE



### 5.3 Transfer of Custody and Shipment

In transferring and shipping samples, the following procedures will be used:

- Samples will be accompanied by a COC Record at all times. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the Record. This Record documents transfer of custody of samples from the sampler to another person, or to the laboratory.
- Samples will be properly packaged for shipment and dispatched to the appropriate laboratory for analysis with a separated signed COC Record enclosed in each sample box or cooler. Shipping containers will be custody-sealed using tamper-proof security tape for shipment to the laboratory by overnight express courier.
- Whenever samples are split with a facility or government agency, a separate COC Record will be prepared for those samples and marked to indicate with whom the samples are being split.
- All packages will be accompanied by the COC Record showing identification of the contents. The original COC Record will accompany the shipment, and a copy will be retained by the Field Supervisor.
- If sent by a common carrier, a bill of lading will be used. Receipts of bills of lading will be retained as part of the permanent documentation.

### 5.4 Laboratory Custody Procedures

The laboratory chosen to conduct the analysis of samples will, as a minimum, check all incoming samples for integrity and note any observations on the original COC Record. The temperature of the cooler blank will be recorded on the COC Record. Each sample will be logged into the laboratory system by assigning it a unique sample number. This number and the field sample identification number will be recorded on the laboratory report. Samples will be stored and analyzed according to specified methods. The original COC Record will be returned to the Project Manager for permanent storage.

The following procedures will be used by the Laboratory Sample Custodian (LSC) in maintaining the chain-of-custody once the samples have arrived at the laboratory:

- The samples are received by the laboratory will be cross-checked to verify that the information on the sample labels matches that on the COC Record included with the shipment.
- If all data and samples are correct, and there has been no tampering with the custody seals, the "received by laboratory" box will be assigned and dated.
- The samples will be distributed to the appropriate analysts with names of individuals who receive samples recorded in internal laboratory records.

If any containers are received broken, samples not properly preserved, holding times have expired, or there are any discrepancies among the COC, sample labels, or requested tests or analyses, the LSC will notify the laboratory project manager. A nonconformance report/corrective action form will be completed, and the



appropriate project manager/coordinator will be notified within 24 hours. At the time of notification, corrective action will be chosen.

For data that are input by an analyst and processed using a computer, a copy of the input will be kept and identified with the project number and other information as needed.

If the data are directly acquired from instrumentation and processed, the analyst will verify that the following are correct:

- Project and sample numbers;
- Calibration constants and response factors;
- Output parameters such as units of measurements; and
- Numerical values used for detection limits if a value is reported as "less than," below detection limit (BDL), or "not detected (ND)."

## **5.5 Final Evidence Files**

This project will require the administration of a central project file. The data and records management protocols will provide controls and retention of all materials related to the project. Record control will include receipt from external sources, transmittals, transfer to storage and indication of record status. Record retention will include receipt at storage areas, indexing, filing, storage, maintenance, and retrieval.

### **5.5.1 Record Control**

All incoming materials related to the project including sketches, correspondence, authorization, and logs will be forwarded to the Project Manager or designee. These documents will be placed in the project file as soon as is practical. If correspondence is required for reference by project personnel, a copy will be made rather than retaining the original. All records will be legible and easily identifiable..

Examples of the types of records that will be maintained in the project file are:

- Field documents;
- Correspondences;
- Photographs;
- Laboratory data;
- Reports; and
- Procurement agreements

Outgoing project correspondences and reports must be reviewed and signed by the Project Manager prior to transmittal. The office copy of all outgoing documents will bear distribution information.

### **5.5.2 Record Status**

To prevent the inadvertent use of obsolete or superseded project-related procedures, all the personnel of the laboratory and project staffs will be responsible for reporting changes in protocol to the Project Manager



and/or the Laboratory manager. The Project Manager and/or Laboratory Manager will then inform the project and laboratory staffs and the Project Quality Assurance Officer of these changes.

Revisions to procedures will be subject to the same level of review and approval as the original document. The revised document will be distributed to all holders of the original document and discussed with project personnel. Outdated procedures will be marked "void." The voided document may be destroyed at the request of the Project Manager with the exception of one copy of the document which will be maintained in the project file. The reasons for and the date the document was voided should be recorded.

### **5.5.3 Record Storage**

All project-related information will be maintained by The contractor. Designated personnel will assure that incoming records are legible and in suitable condition for storage. A records index will be initiated at the beginning of the project. Each document that is placed into the project file will be logged. The logging of the records will be the responsibility of the Project Manager and/or his designee.

Record storage will be performed in two stages:

- Storage during and immediately following the project; and
- Permanent storage of records directly related to the project.

Both phases will use storage facilities that provide a suitable environment to minimize deterioration or damage, and that prevents loss. The facilities will, where possible, have controlled access and provide protection from excess moisture and temperature extremes. Records will be secured in steel file cabinets labeled with the appropriate project identification. The removal of records from all files during both stages will be controlled by the use of withdrawal cards.

At the completion of the project, the Project Manager or his appointed document custodian will be responsible for inventorying the project file. The records contained in the project file will be compared against the records listed on the file index sheets. Discrepancies must be resolved prior to transferring the file to a permanent storage facility. All material from the project file, including drawings, project-related quality assurance documents, and software program documentation and verification records will be permanently retained. Duplicate records may be made and stored in a separate location.

All storage systems will provide for the prompt retrieval of information for reference or use outside the storage areas. Project records will be accessible to NGB for a period of three years after completion of this project.

### **5.5.4 On-Site Control**

A file, similar to the project central file, will be established and maintained by field personnel under the direction of the Field Team Leader. Upon completion of the field program, the on-site file will be integrated with the office project files.



## 6.0 CALIBRATION PROCEDURES AND FREQUENCY

Instruments and equipment used to collect, generate, or measure environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications.

### 6.1 Field Equipment

Calibration of field instruments will be performed at the intervals specified by the manufacturer or more frequently as conditions required. Field instruments will include a pH/ORP meter, thermometer, specific conductivity meter, turbidimeter, dissolved oxygen meter, and PID

- The pH/ORP meter will be calibrated with standard buffer solutions prior to initiation of field activities. In the field, the meter will be calibrated daily with standard buffers before use. Thereafter, the meter will be checked against two buffers as deemed necessary by the Field Team leader. Fresh NIST traceable buffer solutions will be used for each field trip. Calibration procedures and frequency will be recorded in a field logbook, along with the lot numbers of the buffers. The pH/ORP meter will be checked for instrument drift at the end of each day.
- The thermometer will be calibrated by the manufacturer and checked daily with a NIST-certified thermometer.
- The conductivity cells of the specific conductivity meter will be cleaned and checked against known conductivity standards prior to field activities. In the field, the instrument will be checked daily with NIST traceable standards. The meter will be checked for instrument drift at the end of each day.
- The PID meter will be calibrated at the beginning and end of each days use to check for instrument drift. Calibration activities and frequency, calibration gas concentration and lot number will be recorded in the field logbook.
- The turbidimeter will be calibrated daily (and at the beginning of each sampling event) using 1 or 2 standards provided by the manufacturer. The turbidimeter will be checked at the end of each day for instrument drift.
- The DO meter will be calibrated daily and will be checked at the end of each day for instrument drift.

### 6.2 Laboratory Equipment

Calibration of laboratory equipment will be accomplished according to CLP methods for the TCL/TAL analysis and the approved methods for all other analyses. Records of calibration, repairs, or replacement will be filed and maintained by the designated laboratory personnel performing quality control activities. These records will be filed at the location where the work is performed and will be subject to QA audit. For all instruments, the laboratory will maintain a factory-trained repair staff with in-house spare parts, or maintain service contracts with vendors. A summary of typical quality control activities, frequencies, acceptance criteria, and corrective actions is provided in Table 6-1. These activities and actions represent typical laboratory activities. They will be superseded by the laboratory QAPP and method specific SOPs. They laboratory will be required to adhere to the most stringent of the requirements between the methods and the laboratory SOPs when the two are in conflict.



**Table 6-1. Summary of Internal Quality Control Procedures**

| Method  | Parameter | QC Check  | Frequency  | Acceptance Criteria   | Corrective Action   |
|---------|-----------|-----------|--|---|---|
| ILM04.0 | Metals    | Duplicate | One per prep batch (20 samples or less) for each matrix, or per Sample Delivery Group, whichever is more frequent. | RPD <sup>1</sup> must not exceed 20 % for original and duplicate sample values greater than or equal to $5 \times$ CRDL. A control limit of $\pm$ CRDL is used when applicable. | <p>1. If sample and duplicate are below IDL, the RPD is not calculated. If both values are below the CRDL, then no control limit is applicable.</p> <p>2. If sample and/or duplicate is below <math>5 \times</math> CRDL and the absolute difference between the sample and duplicate result is at or below CRDL, results are qualified as "in control."</p> <p>3. If sample and/or duplicate is below <math>5 \times</math> CRDL and the absolute difference between the sample and duplicate result is above the CRDL, results are qualified as "out of control."</p> <p>4. If sample and duplicate are more than <math>5 \times</math> the CRDL and the RPD is greater than 20 %, qualify (flag) the data.</p> <p>5. Document in case narrative.</p> |



**Table 6-1. Summary of Internal Quality Control Procedures (cont.)**

| Method | Parameter           | QC Check   | Frequency                         | Acceptance Criteria | Corrective Action  |
|--------|---------------------|--|-----------------------------------|---------------------|--|
|        | Method (Prep) Blank | One per digestion batch (20 samples or less) for each matrix or for each Sample Delivery Group, whenever is more frequent. | Must not exceed the analyte CRDL. |                     | <ol style="list-style-type: none"><li>1. If the absolute value of the blank is less than or equal to the CRDL, no correction of sample results is performed.</li><li>2. If any analyte concentration in the blank is above the CRDL and the lowest concentration of that analyte in the samples is greater than or equal to <math>10 \times</math> the blank concentration, no corrective action is required.</li><li>3. All samples associated with the contaminated blank with the analyte's concentration less than <math>10 \times</math> the blank concentration and above the CRDL, shall be redigested and reanalyzed for that analyte.</li><li>4. If the blank is below the negative CRDL, all samples reported below <math>10 \times</math> CRDL associated with the blank shall be redigested and reanalyzed.</li><li>5. Document in case narrative.</li></ol> |



**Table 6-1. Summary of Internal Quality Control Procedures (cont.)**

| Method | Parameter                        | QC Check   | Frequency  | Acceptance Criteria   | Corrective Action |
|--------|----------------------------------|--|--|---|-------------------|
|        | LCS                              | One per batch (20 samples or less) for each matrix or per Sample Delivery Group, whichever is more frequent. | Must be within the 80-120 % control limits for an aqueous LCS (exception: Ag and Sb). Solid LCS results must fall within the certified control limits. | 1. For an out of control LCS, the analyses shall be terminated, the problem corrected, and associated samples redigested and reanalyzed.<br>2. Document in case narrative.  |                   |
| Metals | Matrix Spike                     | One per prep batch (20 samples or less) or for each Sample Delivery Group (SDG), whichever is more frequent. | Percent recovery must not exceed the control limits of 75-125%.  | 1. If spiked sample is out of control, qualify (flag) the data.<br>2. If sample concentration is $> 4 \times$ spike concentration, no limits apply.<br>3. If spiked sample $\leq$ spike concentration and LCS and RS are within limits, perform method of standard additions and report result with appropriate flag. |                   |
|        | Initial Calibration              | Daily  | All analyses must fall within the working linear range of the instrument.  | 1. Dilute the sample to bring it within the working range.  |                   |
|        | Initial Calibration Verification | Immediately following initial calibration.   | Percent recovery of all target analytes must fall within 90- 110%.   | 1. Terminate the analysis.<br>Identify the source of contamination . Recalibrate, and reanalyze the preceding 10 samples.   |                   |



**Table 6-1. Summary of Internal Quality Control Procedures (cont.)**

| Method  | Parameter                           | QC Check   | Frequency   | Acceptance Criteria  | Corrective Action   |
|---------|-------------------------------------|--|---|--|---|
|         | Continuing Calibration Verification | At a frequency of 10% or every two hours.          | Percent recovery of all target analytes must fall within 90- 110%.                                | 1. Terminate the analysis.<br>Identify the source of contamination . Recalibrate, and reanalyze the preceding 10 samples.                    |   |
|         | Initial Calibration Blank           | Following the initial calibration verification.    | The blank must be free from contamination above the CRDL.   | 1. Terminate the analysis.<br>Identify the source of contamination . Recalibrate, and reanalyze the preceding 10 samples.                    |   |
|         | Continuing Calibration Blank        | Following the continuing calibration verification. | The blank must be free from contamination above the CRDL.   | 1. Terminate the analysis.<br>Identify the source of contamination . Recalibrate, and reanalyze the preceding 10 samples.                    |   |
| OLM03.1 | VOCs                                | Matrix Spike/Matrix Spike Duplicate (MS/MSD)       | One MS/MSD per prep batch (20 samples or less) for each matrix or for each Sample Delivery Group. | Recoveries and/or RPDs must not exceed subcontracting laboratory's control limits.   | 1. If spiked sample is outside laboratory control limits, qualify (flag) the data.<br>2. If sample concentration is greater than 4× spike concentration, no limits apply. |
|         | Method (Prep) Blank                 |  | One per extraction batch (20 samples or less).  | Must not exceed CRQLs.   | 1. Re-extraction of the entire batch of samples.<br>2. Document on C.A. <sup>3</sup> .  |
|         | LCS                                 |  | One per extraction batch (20 samples or less).  | Must not exceed LCS limits supplied by the manufacturer (when sufficient data are gathered, laboratory established limits will be utilized). | 1. Re-extraction and reanalysis of the entire batch of samples.<br>2. Document on C.A. <sup>3</sup> .   |



**Table 6-1. Summary of Internal Quality Control Procedures (cont.)**

| Method  | Parameter              | QC Check  | Frequency   | Acceptance Criteria  | Corrective Action   |
|---------|------------------------|---|---|--|---|
|         | Surrogates             | Per sample.   | Per analyte as specified in the SOW.  | Per analyte as specified in the SOW.   | 1. Identify potential source of problem. Reanalyze.   |
|         | Internal Standards     | Per sample.   | Per analyte as specified in the SOW.  | Per analyte as specified in the SOW.   | 1. Identify potential source of problem. Reanalyze.   |
|         | Instrument Tune        | Every 12 hours.   | As specified in the SOW.  | As specified in the SOW.   | 1. Identify potential source of problem. Recalibrate. Recalibrate. Reanalyze.   |
|         | Initial Calibration    | As required by failing continuing calibration or change in instrumentation. | Minimum RRF and RSD as specified in the SOW.  | Minimum RRF and %D as specified in the SOW.  | 1. Identify potential source of problem. Recalibrate. Recalibrate. Reanalyze.   |
|         | Continuing Calibration | Every 12 hours.   | Minimum RRF and %D as specified in the SOW.   | Minimum RRF and %D as specified in the SOW.  | 1. Identify potential source of problem. Recalibrate. Recalibrate. Reanalyze.   |
| OLM03.1 | SVOCS                  | Matrix Spike/Matrix Spike Duplicate (MS/MSD)                                | One MS/MSD per prep batch (20 samples or less) for each matrix or for each Sample Delivery Group. | Recoveries and/or RPDs must not exceed subcontracting laboratory's control limits.   | 1. If spiked sample is outside laboratory control limits, qualify (flag) the data.<br>2. If sample concentration is greater than $4 \times$ spike concentration, no limits apply. |
|         | Method (Prep)          | Blank   | One per extraction batch (20 samples or less).  | Must not exceed CRQLs.   | 1. Re-extraction of the entire batch of samples.<br>2. Document on C.A. <sup>3</sup>  |
|         | LCS                    |   | One per extraction batch (20 samples or less).  | Must not exceed LCS limits supplied by the manufacturer (when sufficient data are gathered, laboratory established limits will be utilized). | 1. Re-extraction and reanalysis of the entire batch of samples.<br>2. Document on C.A. <sup>3</sup>   |



**Table 6-1. Summary of Internal Quality Control Procedures (cont.)**

| Method  | Parameter              | QC Check  | Frequency   | Acceptance Criteria  | Corrective Action   |
|---------|------------------------|---|---|--|---|
|         | Surrogates             | Per sample.   | Per analyte as specified in the SOW.  | 1. Identify potential source of problem. Reextract. Reanalyze.                             |   |
|         | Internal Standards     | Per sample.   | Per analyte as specified in the SOW.  | 1. Identify potential source of problem. Reextract. Reanalyze.                             |   |
|         | Instrument Tune        | Every 12 hours.   | As specified in the SOW.  | 1. Identify potential source of problem. Recalibrate. Reanalyze.                           |   |
|         | Initial Calibration    | As required by failing continuing calibration or change in instrumentation. | Minimum RRF and RSD as specified in the SOW.  | 1. Identify potential source of problem. Recalibrate. Reanalyze.                           |   |
|         | Continuing Calibration | Every 12 hours.   | Minimum RRF and %D as specified in the SOW.   | 1. Identify potential source of problem. Recalibrate. Reanalyze.                           |   |
| OLM03.1 | P/PCBS                 | Matrix Spike/Matrix Spike Duplicate (MS/MSD)                                | One MS/MSD per prep batch (20 samples or less) for each matrix or for each Sample Delivery Group. | Recoveries and/or RPDs must not exceed laboratory control limits, qualify (flag) the data. | 1. If spiked sample is outside laboratory control limits, qualify (flag) the data.<br>2. If sample concentration is greater than 4× spike concentration, no limits apply. |
|         | Method (Prep) Blank    |   | One per extraction batch (20 samples or less).  | Must not exceed CRQLs.   | 1. Re-extraction of the entire batch of samples.<br>2. Document on C.A. <sup>3</sup>  |



**Table 6-1. Summary of Internal Quality Control Procedures (cont.)**

| Method             | Parameter              | QC Check  | Frequency  | Acceptance Criteria   | Corrective Action   |
|--------------------|------------------------|---|--|---|---|
|                    | LCS                    | One per extraction batch (20 samples or less).                              | Must not exceed LCS limits supplied by the manufacturer (when sufficient data are gathered, laboratory established limits will be utilized). | 1. Re-extraction and reanalysis of the entire batch of samples.<br>2. Document on C.A. <sup>3</sup> . |   |
|                    | Surrogates             | Per sample.   | Per analyte as specified in the SOW.   | 1. Identify potential source of problem. Reextract. Reanalyze.  |   |
|                    | Initial Calibration    | As required by failing continuing calibration or change in instrumentation. | RSD as specified in the SOW.   | 1. Identify potential source of problem. Recalibrate. Reanalyze.                                      |   |
|                    | Continuing Calibration | Every 12 hours.   | %D as specified in the SOW.  | 1. Identify potential source of problem. Recalibrate. Reanalyze.                                      |   |
| SW-846 Method 8330 | Explosives             | Matrix Spike/Matrix Spike Duplicate (MS/MSD)                                | One MS/MSD per prep batch (20 samples or less) for each matrix or for each Sample Delivery Group.  | Recoveries and/or RPDs must not exceed subcontracting laboratory's control limits.                    | 1. If spiked sample is outside laboratory control limits, qualify (flag) the data.<br>2. If sample concentration is greater than 4× spike concentration, no limits apply. |
|                    | Method (Prep) Blank    | One per extraction batch (20 samples or less).                              | Must not exceed Reporting limits.  | 1. Re-extraction of the entire batch of samples.<br>2. Document on C.A. <sup>3</sup> .                |   |



**Table 6-1. Summary of Internal Quality Control Procedures (cont.)**

| Method           | Parameter              | QC Check  | Frequency  | Acceptance Criteria   | Corrective Action  |
|------------------|------------------------|---|--|---|--|
|                  | LCS                    | One per extraction batch (20 samples or less).                              | Must not exceed LCS limits supplied by the manufacturer (when sufficient data are gathered, laboratory established limits will be utilized). | 1. Re-extraction and reanalysis of the entire batch of samples.<br>2. Document on C.A. <sup>3</sup> . |  |
|                  | Surrogates             | Per sample.   | Per analyte as specified in the laboratory QAPP.   | 1. Identify potential source of problem. Reextract. Reanalyze.  |  |
|                  | Initial Calibration    | As required by failing continuing calibration or change in instrumentation. | RSD as specified in the method   | 1. Identify potential source of problem. Recalibrate. Reanalyze.                                      |  |
|                  | Continuing Calibration | Every 10 samples.   | %D as specified in the method  | 1. Identify potential source of problem. Recalibrate. Reanalyze.                                      |  |
| EPA Method 504.1 | EDB                    | Matrix Spike/Matrix Spike Duplicate (MS/MSD)                                | One MS/MSD per prep batch (20 samples or less) for each matrix or for each Sample Delivery Group.  | Recoveries and/or RPDs must not exceed subcontracting laboratory's control limits.                    | 1. If spiked sample is outside laboratory control limits, qualify (flag) the data.<br>2. If sample concentration is greater than 4 × spike concentration, no limits apply. |
|                  | Method (Prep) Blank    | One per extraction batch (20 samples or less).                              | Must not exceed CRQLs.   | 1. Re-extraction of the entire batch of samples.<br>2. Document on C.A. <sup>3</sup> .                |  |



**Table 6-1. Summary of Internal Quality Control Procedures (cont.)**

| Method             | Parameter           | QC Check  | Frequency  | Acceptance Criteria  | Corrective Action   |
|--------------------|---------------------|---|--|--|---|
|                    | LCS                 | One per extraction batch (20 samples or less).                              | Must not exceed LCS limits supplied by the manufacturer (when sufficient data are gathered, laboratory established limits will be utilized). | 1. Re-extraction and reanalysis of the entire batch of samples.<br>2. Document on C.A. <sup>3</sup> .  |   |
|                    | Surrogates          | Per sample.   | Per analyte as specified in the SOW.   | 1. Identify potential source of problem. Reextract. Reanalyze.   |   |
|                    | Initial Calibration | As required by failing continuing calibration or change in instrumentation. | RSD as specified in the SOW.   | 1. Identify potential source of problem. Recalibrate. Reanalyze.   |   |
| SW-846 Method 8151 | herbicides          | Matrix Spike/Matrix Spike Duplicate (MS/MSD)                                | One MS/MSD per prep batch (20 samples or less) for each matrix or for each Sample Delivery Group.  | Recoveries and/or RPDs must not exceed subcontracting laboratory's control limits.   | 1. If spiked sample is outside laboratory control limits, qualify (flag) the data.<br>2. If sample concentration is greater than 4× spike concentration, no limits apply. |
|                    | Method (Prep Blank) |   | One per extraction batch (20 samples or less).   | Must not exceed Reporting limits.  | 1. Re-extraction of the entire batch of samples.<br>2. Document on C.A. <sup>3</sup> .  |
|                    | LCS                 |   | One per extraction batch (20 samples or less).   | Must not exceed LCS limits supplied by the manufacturer (when sufficient data are gathered, laboratory established limits will be utilized). | 1. Re-extraction and reanalysis of the entire batch of samples.<br>2. Document on C.A. <sup>3</sup> .   |



**Table 6-1. Summary of Internal Quality Control Procedures (cont.)**

| Method                 | Parameter   | QC Check                       | Frequency  | Acceptance Criteria  | Corrective Action  |
|------------------------|---|--------------------------------|--|--|--|
|                        | Surrogates  | Per sample.                    | Per analyte as specified in the laboratory QAPP. | Per analyte as specified in the laboratory QAPP.                 | 1. Identify potential source of problem. Reextract. Reanalyze.   |
| Initial Calibration    | As required by failing continuing calibration or change in instrumentation. | RSD as specified in the method | RSD as specified in the method                   | 1. Identify potential source of problem. Recalibrate. Reanalyze. | 1. Identify potential source of problem. Recalibrate. Reanalyze. |
| Continuing Calibration | Every 10 samples.   | %D as specified in the method  | %D as specified in the method                    | 1. Identify potential source of problem. Recalibrate. Reanalyze. | 1. Identify potential source of problem. Recalibrate. Reanalyze. |

<sup>1</sup> RPD = Relative Percent Difference

<sup>2</sup> N/C = Not Calculable

<sup>3</sup> C.A. = Subcontracting Laboratory Forms (Corrective Action/Out-of-Control Events; Re-Extraction/Out-of-Control Events; Re-Digestion/Out-of-Control Events)



## 7.0 ANALYTICAL PROCEDURES

USEPA CLP published methods OLM03.2 and ILM04.0, or the latest version at the time of analysis, will be used for all analyses for which such methods exist. EDB and MTBE aqueous analysis will be performed according to EPA methods 504.2 and 8021, respectively. EDB and MTBE soil analyses will be performed by the CLP SOW OLM03.2 or 8021 as determined by the laboratories ability to achieve the desired reporting levels. Explosives will be analyzed for using Test Methods for Evaluating Solid Waste, SW-846 Method 8330, Method 8515 and the Cold Regions Research and Engineering Laboratory (CRREL) colorimetric method to measure RDX. Herbicides will be analyzed for using Test Methods for Evaluating Solid Waste, SW-846 Method 8151. TCLP analysis for site was disposal purposes will be performed according to Federal Register Vol. 57, No. 227, dated 11/92 and Vol. 55, No. 126, dated 6/90. These procedures are in accordance with the Quality Assurance Project Plan (QAPP) and Standard Operating Procedures (SOP) for environmental investigations at MMR.

Tables 7-1a through 7-1g show the lists of target compounds, the analytical methods references, and typical method detection limits that will be used for the analytical program. These are intended to be finalized upon selection of an analytical laboratory. The selected laboratory MDLs will be submitted prior to initiation of the sampling effort. Specific methods may be substituted as long as they demonstrate equivalency with respect to overall quality assurance and attain the desired reporting limits.



TABLE 7-1 (a): LIST OF EXPLOSIVES COMPOUNDS; ANALYTICAL METHODS  
REFERENCE AND DETECTION LIMITS FOR AQUEOUS AND SOIL SAMPLES

| Parameter                  | Method Reference | Detection Limit |            |
|----------------------------|------------------|-----------------|------------|
|                            |                  | Water(ug/L)     | Soil(ug/g) |
| HMX                        | EPA 8330         | 0.072           | 0.076      |
| RDX                        | EPA 8330         | 0.23            | 0.19       |
| RDX                        | CRREL            | TBD             | TBD        |
| 1,3-Dinitrobenzene         | EPA 8330         | 0.088           | 0.043      |
| 1,3,5-Trinitrobenzene      | EPA 8330         | 0.066           | 0.078      |
| Tetryl                     | EPA 8330         | 0.25            | 0.17       |
| Nitrobenzene               | EPA 8330         | 0.19            | 0.084      |
| 2,4,6-Trinitrotoluene      | EPA 8330         | 0.21            | 0.067      |
| 2-Amino-4,6-Dinitrotoluene | EPA 8330         | 0.11            | 0.083      |
| 4-Amino-2,6-Dinitrotoluene | EPA 8330         | 0.058           | 0.14       |
| 2,6-Dinitrotoluene         | EPA 8330         | 0.17            | 0.073      |
| 2,4-Dinitrotoluene         | EPA 8330         | 0.11            | 0.054      |
| 2-Nitrotoluene             | EPA 8330         | 0.21            | 0.24       |
| 3-Nitrotoluene             | EPA 8330         | 0.3             | 0.23       |
| 4-Nitrotoluene             | EPA 8330         | .20             | 0.24       |
| 2,6-Diamino-4-nitrotoluene | EPA 8330         | TBD             | TBD        |
| 2,4-Diamino-6-nitrotoluene | EPA 8330         | TBD             | TBD        |
| PETN                       | EPA 8330         | TBD             | TBD        |
| AP/PA                      | EPA 8330         | TBD             | TBD        |
| 2,4,6-Trinitrotoluene      | EPA 8330         | TBD             | TBD        |

TBD - to be determined



TABLE 7-1 (b): TARGET COMPOUND LIST FOR VOLATILES; METHOD REFERENCES, MCL's  
SSL's AND DETECTION LIMITS

| Analyte(s)                | Contaminant Level<br>Water (ug/L) | Maximum<br>Soil<br>Level<br>(mg/Kg) | Generic Soil<br>Level<br>(mg/Kg) | Method<br>Detection Limit<br>Water (ug/L) | Method<br>Detection Limit<br>Soil (ug/g) |
|---------------------------|-----------------------------------|-------------------------------------|----------------------------------|---|--|
| Chloromethane             | n/a                               | n/a                                 | n/a                              | 0.252                                     | 0.0013                                   |
| Bromomethane              | n/a                               | n/a                                 | n/a                              | 0.250                                     | 0.00067                                  |
| Vinyl Chloride            | 2                                 | 0.01                                | 0.247                            | 0.00072                                   |  |
| Chloroethane              | n/a                               | n/a                                 | 0.288                            | 0.00087                                   |  |
| Methylene Chloride        | n/a                               | 0.02                                | 0.362                            | 0.00041                                   |  |
| Carbon Disulfide          | n/a                               | 32                                  | 0.249                            | 0.00068                                   |  |
| 1,1-Dichloroethene        | 7                                 | 0.06                                | 0.229                            | 0.00038                                   |  |
| cis-1,2-Dichloroethene    | 70                                | 0.4                                 | 0.252                            | 0.00045                                   |  |
| trans-1,2-Dichloroethene  | 100                               | 0.7                                 | 0.295                            | 0.00055                                   |  |
| Chloroform                | 100                               | 0.6                                 | 0.308                            | 0.00038                                   |  |
| 1,2-Dichloroethane        | 5                                 | 23                                  | 0.369                            | 0.00027                                   |  |
| 2-Butanone                | n/a                               | n/a                                 | 1.002                            | 0.0018                                    |  |
| 1,1,1-Trichloroethane     | 200                               | 2                                   | 0.295                            | 0.00022                                   |  |
| Carbon Tetrachloride      | 5                                 | 0.07                                | 0.288                            | 0.00061                                   |  |
| Vinyl Acetate             | n/a                               | 170                                 | 1.430                            | 0.0027                                    |  |
| Bromodichloromethane      | 100                               | 0.6                                 | 0.319                            | 0.00027                                   |  |
| 1,1,2,2-Tetrachloroethane | n/a                               | 0.0033                              | 0.329                            | 0.00041                                   |  |
| 1,2-Dichloropropane       | 5                                 | 0.03                                | 0.304                            | 0.00041                                   |  |
| cis-1,3-Dichloropropene   | n/a                               | 0.0044                              | 0.309                            | 0.00023                                   |  |
| trans-1,3-Dichloropropene | n/a                               | 0.0044                              | 0.343                            | 0.00016                                   |  |
| Trichloroethene           | 5                                 | 0.06                                | 0.356                            | 0.00056                                   |  |
| Dibromomethane            | n/a                               | 0.4                                 | 0.329                            | 0.00019                                   |  |
| 1,1,2-Trichloroethane     | 5                                 | 0.02                                | 0.434                            | 0.00013                                   |  |
| Benzene                   | 5                                 | 0.03                                | 0.288                            | 0.00039                                   |  |
| 2-Chloroethyl Vinyl Ether | n/a                               | n/a                                 | 1.396                            | 0.00029                                   |  |
| Bromotorm                 | 100                               | 0.8                                 | 0.319                            | 0.0002                                    |  |
| 2-Hexanone                | n/a                               | n/a                                 | 0.417                            | 0.00039                                   |  |
| 4-Methyl-2-Pentanone      | n/a                               | n/a                                 | 0.463                            | 0.00087                                   |  |
| Tetrachloroethene         | 5                                 | 0.06                                | 0.288                            | 0.00054                                   |  |
| Toluene                   | 1000                              | 12                                  | 0.313                            | 0.00075                                   |  |
| Chlorobenzene             | n/a                               | 1                                   | 0.325                            | 0.00036                                   |  |
| Ethylbenzene              | 700                               | 13                                  | 0.269                            | 0.00061                                   |  |
| Styrene                   | 100                               | 4                                   | 0.282                            | 0.00026                                   |  |
| Total Xylenes             | 10000                             | 600                                 | 0.867                            | 0.0011                                    |  |

Volatile Organics in water by GC/MS EPA 8260 (25ml Purge)

Volatile Organics in soil by GC/MS EPA 8240 (Capillary Column)



TABLE 7-1(c): TARGET ANALYTE LIST FOR INORGANICS CONSISTENTS; METHOD REFERENCES, MCL's, SSL's, AND DETECTION LIMITS

| Analyte(s)      | Method Reference | Maximum Contaminant Level Water (ug/L) | Generic Soil Screening Level (mg/Kg) | Method Detection Limit |              |
|-----------------|------------------|--|--------------------------------------|------------------------|--------------|
|                 |                  |  |                                      | Water (ug/L)           | Soil (mg/Kg) |
| Aluminum        | CLP              | n/a                                    | n/a                                  | 15                     | 10           |
| Antimony        | CLP              | 6                                      | 5                                    | 43                     | 1.7          |
| Arsenic         | CLP              | 50                                     | 29                                   | ND                     | ND           |
| Barium          | CLP              | 2000                                   | 1600                                 | 0.8                    | 0.12         |
| Beryllium       | CLP              | 4                                      | 63                                   | 0.2                    | 0.043        |
| Cadmium         | CLP              | 5                                      | 8                                    | 3.2                    | ND           |
| Chromium        | CLP              | 100                                    | 38                                   | 1.8                    | 0.39         |
| Cobalt          | CLP              | n/a                                    | n/a                                  | 5                      | 0.38         |
| Copper          | CLP              | 1300                                   | n/a                                  | 8.7                    | 0.55         |
| Iron            | CLP              | n/a                                    | n/a                                  | 13                     | 1.9          |
| Lead            | CLP              | 15                                     | 400 <sup>1</sup>                     | ND                     | ND           |
| Magnesium       | CLP              | n/a                                    | n/a                                  | 24                     | 0.86         |
| Manganese       | CLP              | n/a                                    | n/a                                  | 0.29                   | 0.14         |
| Mercury         | CLP-CVAA         | 2                                      | 2                                    | 0.047                  | 0.034        |
| Nickel          | CLP              | 100 <sup>2</sup>                       | 130                                  | 7.4                    | 0.89         |
| Potassium       | CLP              | n/a                                    | n/a                                  | 18                     | 3.1          |
| Selenium        | CLP              | 50                                     | 5                                    | ND                     | ND           |
| Silver          | CLP              | n/a                                    | 34                                   | 4.5                    | 0.16         |
| Sodium          | CLP              | n/a                                    | n/a                                  | 37                     | 15           |
| Thallium        | CLP              | 2                                      | 0.7                                  | ND                     | ND           |
| Vanadium        | CLP              | n/a                                    | 6000                                 | 1.7                    | 0.16         |
| Zinc            | CLP              | n/a                                    | 12000                                | 7.7                    | 0.98         |
| Cyanide         | EPA 9012         | 200                                    | n/a                                  | 2.4                    | 0.096        |
| Phosphorus      | 4500-PB          | n/a                                    | n/a                                  | TBD                    | TBD          |
| Nitrate/nitrite | EPA 9056         | n/a                                    | n/a                                  | TBD                    | TBD          |
| Ammonia         | 4500-N           | n/a                                    | n/a                                  | TBD                    | TBD          |

<sup>1</sup> Based on the Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities (US EPA, 1994).

<sup>2</sup> Draft standard

CVAA - Cold Vapor Atomic Absorption

ND- Not Determined



TABLE 7-1 (d): TARGET COMPOUND LIST FOR SEMI-VOLATILES; METHOD REFERENCES, MCL'S, SSL's, AND DETECTION LIMITS

| Analyte(s)                   | Method Reference | Maximum Contaminant Level Water (µg/L) | Screening Level (mg/Kg) | Generic Soil Screening Level (mg/Kg) | Method Detection Limit Water (µg/L) | Method Detection Limit Soil (µg/g) |
|------------------------------|------------------|--|-------------------------|--------------------------------------|-------------------------------------|------------------------------------|
| N-Nitrosodimethylamine       | CLP              | n/a                                    | 1                       | 1                                    | 0.23                                | 0.017                              |
| Phenol                       | CLP              | n/a                                    | 100                     | 0.62                                 | 0.0082                              |                                    |
| Aniline                      | CLP              | n/a                                    | n/a                     | 0.26                                 | 0.051                               |                                    |
| bis(2-Chloroethyl) ether     | CLP              | n/a                                    | 0.0004                  | 0.29                                 | 0.011                               |                                    |
| 2-Chlorophenol               | CLP              | n/a                                    | 4                       | 0.27                                 | 0.011                               |                                    |
| 1,2-Dichlorobenzene          | CLP              | 600                                    | 17                      | 0.32                                 | 0.0086                              |                                    |
| 1,3-Dichlorobenzene          | CLP              | 600                                    | n/a                     | 0.36                                 | 0.0096                              |                                    |
| 1,4-Dichlorobenzene          | CLP              | 75                                     | 2                       | 0.32                                 | 0.0089                              |                                    |
| Benzyl Alcohol               | CLP              | n/a                                    | n/a                     | 0.29                                 | 0.01                                |                                    |
| 2-Methylphenol               | CLP              | n/a                                    | 15                      | 0.058                                | 0.0082                              |                                    |
| bis(2-Chloroisopropyl) ether | CLP              | n/a                                    | n/a                     | 0.35                                 | 0.056                               |                                    |
| 4-Methylphenol               | CLP              | n/a                                    | n/a                     | 0.050                                | 0.0077                              |                                    |
| N-Nitroso-n-dipropylamine    | CLP              | n/a                                    | 5 E-5                   | 0.27                                 | 0.012                               |                                    |
| Hexachloroethane             | CLP              | n/a                                    | 0.5                     | 0.35                                 | 0.009                               |                                    |
| Nitrobenzene                 | CLP              | n/a                                    | 0.1                     | 0.36                                 | 0.034                               |                                    |
| Isophorone                   | CLP              | n/a                                    | 0.5                     | 0.22                                 | 0.0086                              |                                    |
| 2-Nitrophenol                | CLP              | n/a                                    | n/a                     | 0.28                                 | 0.0085                              |                                    |
| 2,4-Dichlorophenol           | CLP              | n/a                                    | 1                       | 0.16                                 | 0.0085                              |                                    |
| Benzoic Acid                 | CLP              | n/a                                    | 400                     | 6.6                                  | 0.025                               |                                    |
| bis(2-Chloroethoxy) methane  | CLP              | n/a                                    | n/a                     | 0.25                                 | 0.0087                              |                                    |
| 1,2,4-Trichlorobenzene       | CLP              | 70                                     | 5                       | 5                                    | 0.0096                              |                                    |
| Naphthalene                  | CLP              | n/a                                    | 84                      | 0.29                                 | 0.0092                              |                                    |
| 4-Chloroaniline              | CLP              | n/a                                    | 0.7                     | 0.77                                 | 0.047                               |                                    |
| Hexachlorobutadiene          | CLP              | n/a                                    | 2                       | 0.30                                 | 0.008                               |                                    |
| 4-Chloro-3-Methylphenol      | CLP              | n/a                                    | n/a                     | 0.28                                 | 0.0095                              |                                    |
| 2-Methylnaphthalene          | CLP              | n/a                                    | n/a                     | 10                                   | 330                                 |                                    |
| Hexachlorocyclopentadiene    | CLP              | 50                                     | 400                     | 0.17                                 | 0.0055                              |                                    |
| 2,4,6-Trichlorophenol        | CLP              | n/a                                    | 0.2                     | 10                                   | 0.0095                              |                                    |
| 2,4,5-Trichlorophenol        | CLP              | n/a                                    | 270                     | 10                                   | 0.009                               |                                    |
| 2-Chloronaphthalene          | CLP              | n/a                                    | n/a                     | 0.12                                 | 0.0037                              |                                    |
| 2-Nitroaniline               | CLP              | n/a                                    | n/a                     | 0.11                                 | 0.0096                              |                                    |
| Dimethylphthalate            | CLP              | n/a                                    | n/a                     | 0.084                                | 0.0089                              |                                    |



TABLE 7-1 (d) (Cont.: TARGET COMPOUND LIST FOR SEMI-VOLATILES; METHOD REFERENCES, MCL's, SSL's, AND DETECTION LIMITS

| Analyte(s)                  | Method Reference | Maximum Contaminant Level Water (ug/L) | Screening Level (mg/Kg) | Method Detection Limit |             |
|-----------------------------|------------------|--|-------------------------|------------------------|-------------|
|                             |                  |  |                         | Water (ug/L)           | Soil (ug/g) |
| Aceanaphthene               | CLP              | n/a                                    | 570                     | 0.21                   | 0.0079      |
| 3-Nitroaniline              | CLP              | n/a                                    | n/a                     | 0.085                  | 0.025       |
| 2-Nitrophenol               | CLP              | n/a                                    | n/a                     | 0.24                   | 0.0085      |
| 4-Nitrophenol               | CLP              | n/a                                    | n/a                     | 0.39                   | 0.022       |
| Dibenzofuran                | CLP              | n/a                                    | n/a                     | 0.11                   | 0.0034      |
| 2,4-Dinitrotoluene          | CLP              | n/a                                    | 0.00088                 | 0.064                  | 0.015       |
| 2,6-Dinitrotoluene          | CLP              | n/a                                    | 0.0007                  | 0.22                   | 0.0073      |
| Diethylphthalate            | CLP              | n/a                                    | 470                     | 0.23                   | 0.011       |
| 4-Chlorophenyl phenyl ether | CLP              | n/a                                    | n/a                     | 0.23                   | 0.0067      |
| Fluorene                    | CLP              | n/a                                    | 560                     | 0.22                   | 0.0084      |
| 4-Nitroaniline              | CLP              | n/a                                    | n/a                     | 1.3                    | 0.066       |
| 4,6-Dinitro-2-methylphenol  | CLP              | n/a                                    | n/a                     | 3.4                    | 0.007       |
| N-Nitrosodiphenylamine      | CLP              | n/a                                    | 1                       | 0.23                   | 0.017       |
| 4-Bromophenyl phenyl ether  | CLP              | n/a                                    | n/a                     | 0.21                   | 0.0072      |
| Hexachlorobenzene           | CLP              | 1                                      | 2                       | 0.21                   | 0.0068      |
| Pentachlorophenol           | CLP              | 1                                      | 0.03                    | 0.24                   | 0.0083      |
| Phenanthrene                | CLP              | n/a                                    | n/a                     | 5                      | 0.0074      |
| Anthracene                  | CLP              | n/a                                    | 12000                   | 0.24                   | 0.0088      |
| Di-n-Butylphthalate         | CLP              | n/a                                    | 2300                    | 0.41                   | 0.059       |
| Fluoranthene                | CLP              | n/a                                    | 4300                    | 0.23                   | 0.0091      |
| Benzidine                   | CLP              | n/a                                    | n/a                     | ND                     | ND          |
| Pyrene                      | CLP              | n/a                                    | 4200                    | 5                      | 0.016       |
| Butyl Benzyl Phthalate      | CLP              | n/a                                    | 930                     | 0.64                   | 0.13        |
| 3,3'-Dichlorobenzidine      | CLP              | n/a                                    | 0.007                   | 4.0                    | 0.036       |
| Benzo(a)Anthracene          | CLP              | n/a                                    | 2                       | 0.19                   | 0.0076      |
| Bis(2-Ethylhexyl)Phthalate  | CLP              | n/a                                    | 3600                    | 0.30                   | 0.12        |
| Chrysene                    | CLP              | n/a                                    | 160                     | 0.21                   | 0.0091      |
| Di-n-octyl Phthalate        | CLP              | n/a                                    | 2300                    | 0.15                   | 0.011       |
| Benzo(b)Fluoranthene        | CLP              | n/a                                    | 5                       | 0.16                   | 0.0097      |
| Benzo(k)Fluoranthene        | CLP              | n/a                                    | 49                      | 0.16                   | 0.0095      |
| Benzo(a)Pyrene              | CLP              | 0.2                                    | 8                       | 0.15                   | 0.0088      |
| Indeno(1,2,3-cd)Pyrene      | CLP              | n/a                                    | 14                      | 0.22                   | 0.013       |
| Dibenzo(a,h)anthracene      | CLP              | n/a                                    | 2                       | 0.28                   | 0.012       |
| Benzo(g,h,i)Perylene        | CLP              | n/a                                    | n/a                     | 0.32                   | 0.019       |



TABLE 7-1 (e): TARGET COMPOUND LIST FOR PESTICIDES/PCBs; METHOD REFERENCES,  
MCL's, SSL's, AND DETECTION LIMITS

| Analyte            | Method Reference | Maximum Contaminant Level Water (ug/L) | Generic Soil Screening Level (mg/Kg) | Water (ug/L) | Soil (ug/g) | Typical Method Detection Limit |
|--------------------|------------------|--|--------------------------------------|--------------|-------------|--------------------------------|
| Alpha-BHC          | CLP              | n/a                                    | 0.0005                               | 0.0011       | 0.000064    |                                |
| Beta-BHC           | CLP              | n/a                                    | 0.003                                | 0.0012       | 0.000052    |                                |
| Delta-BHC          | CLP              | n/a                                    | n/a                                  | 0.0012       | 0.000083    |                                |
| Gamma-BHC(Lindane) | CLP              | 0.2                                    | 0.009                                | 0.0011       | 0.000071    |                                |
| Heptachlor         | CLP              | 0.4                                    | 23                                   | 0.0013       | 0.000038    |                                |
| Aldrin             | CLP              | n/a                                    | 0.5                                  | 0.0016       | 0.000117    |                                |
| Heptachlor Epoxide | CLP              | 0.2                                    | 0.7                                  | 0.0011       | 0.000054    |                                |
| Endosulfan I       | CLP              | n/a                                    | 18                                   | 0.0013       | 0.000111    |                                |
| Dieledrin          | CLP              | n/a                                    | 0.004                                | 0.0012       | 0.000042    |                                |
| 4,4'-DDE           | CLP              | 2                                      | 54                                   | 0.0023       | 0.000042    |                                |
| Endrin             | CLP              | n/a                                    | 1                                    | 0.0021       | 0.000097    |                                |
| Endosulfan II      | CLP              | n/a                                    | n/a                                  | 0.0031       | 0.00016     |                                |
| 4,4'-DDT           | CLP              | n/a                                    | 32                                   | 0.0019       | 0.000043    |                                |
| Endrin Aldehyde    | CLP              | 40                                     | n/a                                  | 0.0023       | 0.00015     |                                |
| Methoxychlor       | CLP              | 2                                      | 160                                  | 0.014        | 0.00035     |                                |
| Chlordane *        | CLP              | 3                                      | 10                                   | 0.016        | 0.00093     |                                |
| Toxaphene *        | CLP              | 0.5 <sup>1</sup>                       | 31                                   | 0.43         | 0.013       |                                |
| AROCLOR-1016 *     | CLP              | 0.5 <sup>1</sup>                       | n/a                                  | 0.41         | 0.00092     |                                |
| AROCLOR-1221 *     | CLP              | 0.5 <sup>1</sup>                       | n/a                                  | 0.22         | 0.009       |                                |
| AROCLOR-1232 *     | CLP              | 0.5 <sup>1</sup>                       | n/a                                  | 0.15         | 0.00337     |                                |
| AROCLOR-1242 *     | CLP              | 0.5 <sup>1</sup>                       | n/a                                  | 0.67         | 0.0024      |                                |
| AROCLOR-1248 *     | CLP              | 0.5 <sup>1</sup>                       | n/a                                  | 0.29         | 0.00074     |                                |
| AROCLOR-1254 *     | CLP              | 0.5 <sup>1</sup>                       | n/a                                  | 0.016        | 0.00071     |                                |
| AROCLOR-1260 *     | CLP              | 0.5 <sup>1</sup>                       | n/a                                  | 0.025        | 0.00084     |                                |

<sup>1</sup> MCL for total PCB concentrations is 0.5 ug/L.

\* Multipeak analytes



TABLE 7-1 (f): ORGANIC ANALYTE LIST; METHOD REFERENCE,  
MCL's, SSL's, AND DETECTION LIMITS

| Target Compounds         | Method Reference | Maximum Contaminant Level Water (ug/L) | Generic Soil Screening Level (mg/Kg) | Typical Detection Limit |             |
|--------------------------|------------------|--|--------------------------------------|-------------------------|-------------|
|                          |                  |  |                                      | Water (ug/L)            | Soil (ug/g) |
| 2,4-D                    | EPA 8151         | 70                                     | n/a                                  | 0.043                   | 0.0059      |
| Dalapon                  | EPA 8151         | 200                                    | n/a                                  | 0.2                     | 0.029       |
| 2,4-DB                   | EPA 8151         | n/a                                    | n/a                                  | 0.16                    | 0.003       |
| Dicamba                  | EPA 8151         | n/a                                    | n/a                                  | 0.082                   | 0.0036      |
| Dichlorprop              | EPA 8151         | n/a                                    | n/a                                  | 0.36                    | 0.0088      |
| Dinoseb                  | EPA 8151         | 7                                      | n/a                                  | 0.11                    | *           |
| Pentachlorophenol        | EPA 8151         | 1                                      | 0.03                                 | n/a                     | 25          |
| Picloram                 | EPA 8151         | 500                                    | n/a                                  | n/a                     | 25          |
| 2,4,5-TP (Silvex)        | EPA 8151         | 50                                     | 270                                  | n/a                     | 25          |
| 3,5-Dichlorobenzoic Acid | EPA 8151         | n/a                                    | n/a                                  | n/a                     | 25          |
| 4-Nitrophenol            | EPA 8151         | n/a                                    | n/a                                  | n/a                     | 25          |
| Chloramben               | EPA 8151         | n/a                                    | n/a                                  | n/a                     | 25          |
| Bentazon                 | EPA 8151         | n/a                                    | n/a                                  | n/a                     | 25          |
| Acifluorfen              | EPA 8151         | n/a                                    | n/a                                  | n/a                     | 25          |
| EDB (water)              | EPA 504          | 0.05                                   | n/a                                  | 0.02                    | n/a         |
| EDB (soil)               | EPA 8021         | n/a                                    | n/a                                  | TBD                     | TBD         |
| MTBE                     | EPA 8021         | n/a                                    | n/a                                  | TBD                     | TBD         |



## 8.0 FIELD AND LABORATORY CONTROL CHECKS

### 8.1 Field Quality Control Checks

As a check on field sampling quality assurance and quality control (QA/QC), trip blanks, field blanks, equipment rinsate samples, and field duplicates will be sent to the laboratory with specified frequencies. The frequency with which these samples will be taken, and the number of such samples, are discussed in this section. The numbers, types, and analytical parameters for quality control samples were summarized in Table 4-1.

#### 8.1.1 Trip Blanks

Trip blanks are used to assure that contamination is not caused by sample storage or shipping. A trip blank is defined as a sample bottle filled by the laboratory with analyte-free laboratory reagent water (HPLC-grade), transported to the site, handled like a sample but not opened, and returned to the laboratory for analysis. One trip blank will be sent with every container of volatile organic compounds samples sent to the laboratory. Trip blanks are analyzed for volatile organic compounds only.

#### 8.1.2 Field Blanks

Field blanks are used to check the quality of water used in the decontamination process. A field blank is defined as water collected in a sample container at the site, processed like a sample, and transported to the laboratory for analysis. The water source must be the same water used in the final decontamination rinse (analyte-free, deionized or HPLC grade) and water used for steam cleaning. The decontamination water is generally organic-free deionized water. The water used for steam cleaning is potable tap water. A field blank will be collected for each sampling event and each water source. Field blanks will be analyzed for all target analytes.

#### 8.1.3 Equipment Rinsate Blanks

Equipment rinsate blanks are used to determine the effectiveness of the field decontamination process. Equipment rinsate blanks are defined as deionized water used for decontamination; e.g., poured over field equipment that has been decontaminated. This rinsate water is then transferred to a sample bottle. Equipment rinsate samples will be taken every day that decontamination occurs. The equipment rinsate samples will be analyzed for the same analytes as the samples which are collected that day.

#### 8.1.4 Field Duplicates and Split Samples

Field duplicates are used to measure precision of laboratory analyses. A field duplicate is defined as two or more samples collected independently at a sampling location during a single act of sampling. The total number of field duplicates for each analysis is equal to 10 percent of the samples collected, rounded to the next whole number, i.e. for 10 samples it would mean 1 duplicate; but for 11 samples, 2 duplicates would be required.

Field duplicates will be indistinguishable by the laboratory from other samples. Therefore, one complete sample set will be identified with a "coded" or false identifier which will be in the same format as other identifier used with this sample matrix. Both the false and true identifiers will be recorded in the field notebook. On the COC Records, the "coded" identifier will be used.

### 8.2 Laboratory Quality Control Checks

Quality control data are necessary to determine precision and accuracy of the analyses, and to demonstrate the absence of interferences and contamination of glassware and reagents. Laboratory-generated QC will consist



of blanks, replicates, standards, matrix spikes, surrogate spikes and blanks. Depending upon the particular method used, QC may or sample duplicate will be analyzed at a frequency of one for each 20 samples. EPA recommended matrix spiking solutions will be used to determine matrix effects. Surrogates will be added to all samples requiring GC/MS analyses or whenever the method specifies. At a minimum, one method blank will be processes for every 20 samples analyzed. Blank samples will be analyzed in order to assess possible contamination and determine which corrective measures may be taken, if necessary.

#### **8.2.1 Analytical Replicates**

Replicate samples are aliquots of a single sample that are split upon arrival at the laboratory or prior to analysis. Since it is anticipated that the concentrations of most parameters will be below the laboratory detection limits, precision data on replicate analyses will largely be derived from matrix spike duplicate data. Significant differences between two replicates that are split in a controlled laboratory environment will result in flagging of the affected analytical results.

#### **8.2.2 Surrogate Spike Analysis**

Surrogate spike analysis is used to determined the efficiency of recovery of analytes in the sample preparation and analysis. Calculated percentage recovery of the spike is used as a measure of the accuracy of the total analytical method. A surrogate spike is prepared by adding to a sample (before extraction) a known amount of pure compound similar to that for which the sample is being analyzed. Surrogate compounds will be added to all samples that are to be analyzed for volatiles, semi-volatiles, pesticides/PCBs and EDB, including method blanks, duplicate samples, and matrix spikes using the compounds recommended in the respective methods. The compounds that will be used as surrogates and the required surrogate spike recovery limits are given in in the MMR quality assurance manual (CDM, 1993). If the recovery does not fall within these limits, the corrective actions described in the method will be implemented.

#### **8.2.3 Matrix Spike/Duplicate Spike Analysis**

This technique is used to determine the effect of matrix interference on analytical results. Aliquots of the same sample are prepared in the laboratory and each aliquot receives consistent treatment throughout the analytical method. Spikes are added at concentrations specified in the methods. The percent difference between the values of the spike duplicates is taken as a measure of the precision of the analytical method. A matrix spike duplicate sample is prepared in the same manner as the matrix spike sample. The matrix spiking compounds and control limits for percent recovery and RPDs will be provided following the selection of an analytical laboratory and will follow the EPA CLP SOW criteria where appropriate. These limits will be provided prior to the initiation of sampling. Matrix spike and matrix spike duplicate analyses will be used for TCL Volatiles, TCL Semi-volatiles, TCL Pesticide/PCB, explosives by 8330, herbicides by 8151, and EDB/MTBE analyses. Matrix spike analysis and sample duplicate analysis will be used for TAL Inorganics and water quality , wet chemistry parameters.

The results of the analyses will be reviewed by the laboratory supervisor. Deviations from the established QC criteria will be noted and reanalysis, or other corrective action will be instituted as appropriate for the situation.

#### **8.2.4 Reagent Blanks**

Reagent blanks will be run for all appropriate analyses to verify that the procedures used do not introduce contaminants that affect the analytical results. The reagent blank will be prepared by addition of all reagents to a substance of similar matrix as the sample. This blank will then undergo all of the procedures required for sample preparation. The resultant solution will be analyzed with the field samples prepared under identical conditions.



#### **8.2.5 Performance Evaluation Samples**

A performance evaluation (PE) sample will be obtained which contains certified concentrations of the target compounds which are anticipated to be identified at the site. The PE sample will be submitted to the laboratory double-blind; the sample will be introduced into the sampling stream in the field and will be analyzed by the laboratory without the laboratory's knowledge of its significance. The results from the PE sample analysis will be evaluated with respect to proper identification of spiked target compounds and the acceptability of the resulting quantitation. Corrective action will be based upon the severity of the deficiency in the identification and quantitation of the spiked target compounds. Corrective action may include up to rejection of the data for that compound or class of compounds.

#### **8.3 Quality Control and Audit**

Quality control results will be calculated by the analyst and reviewed by the laboratory supervisor to determine the accuracy and precision of the analytical results. The Laboratory Supervisor or the Laboratory Manager will review all final reports and associated quality control data. Approval will be indicated by signature. Results will be recorded on the QC report. The QC results will also be used to prepared control charts for each test and type of matrix.



## 9.0 DATA REDUCTION, VALIDATION, AND REPORTING

### 9.1 Data Reduction

#### 9.1.1 Field Data

Field measurements will be made by qualified field geologists, engineers, environmental scientists, and/or technicians.

Field data will be validated using four different procedures:

- Routine checks will be made during the processing of data, e.g., looking for errors in identification codes.
- Internal consistency of a data set will be evaluated. This step will involve plotting the data and testing for outliers.
- Checks for consistency of the data set over time will be performed. This can be accomplished by visually comparing data sets against gross upper limits obtained from historical data sets, or by testing for historical consistency. Anomalous data will be identified.
- Checks may be made for consistency with parallel data sets; i.e., data sets obtained from the same population (for example, from the same region of the aquifer).

The purpose of these validation checks and tests is to identify outliers; i.e., an observation that does not conform to the pattern established by other observations. Outliers may be the result of transcription errors or instrumentation breakdowns. Outliers may also be manifestations of a greater degree of spatial or temporal variability than expected.

After an outlier has been identified, a decision concerning its fate must be made. Obvious mistakes in data will be corrected when possible, and the correct values inserted. If the correct values cannot be obtained, the data may be excluded. An attempt will be made to explain the existence of the outlier. If no plausible explanation can be found for the outlier, it may be excluded, but a note to that effect will be included in the report. Also, an attempt will be made to determine the effect of the outlier with both inclusion and exclusion from the data set.

#### 9.1.2 Laboratory Data

The procedures used for calculations and data reduction are specified in each analysis method reference previously. Concentration units will be listed on reports and any special conditions noted. The analysis report includes the unique sample number assigned to each sample, details of sample receipt, and report preparation.

### 9.2 Data Review and Validation

For 10 percent of the samples to be analyzed for TCL/TAL, data validation will be performed according to EPA Region I New England Data Validation Function Guidelines for Evaluation of Environmental Analyses, and Region I Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses, at the Tier III Level as referenced in the document Region I Tiered Organic and Inorganic Data Validation Guidelines, dated July 1, 1993. The analytical results for the remaining samples analyzed for TCL/TAL will be validated at the Region 1 Tier II level. Tier II and III data validation is performed in accordance with the Region I Completeness Evidence Audit Program and the Region I Laboratory Data Validation Functional Guidelines.



Analytical results for samples subjected to analysis for herbicides and explosives will be validated based on the Region I guidelines with control limits as stated in this QAPP at 10% Tier III Level. The remaining samples will be validated at Region I Tier II Level.

Analytical results for samples subjected to analysis for EDB and MTBE will be validated based on the Region I guidelines with control limits as stated in this QAPP at a Tier II level.

### **9.3 Reporting**

For all analyses, data reporting will be according to CLP requirements as published in the current Statements of Work. For all analyses, as a minimum, the laboratory will indicate traceability to samples analyzed and contain the following information:

- Project identification.
- Field sample number.
- Laboratory sample number.
- Sample matrix description
- Data of sample collection.
- Data of sample receipt at laboratory.
- Analytical method description and reference citation.
- Individual parameter results.
- Date of analysis (extraction, first run, and subsequent runs).
- Quantitation limits achieved.
- Dilution or concentration factors.
- Corresponding QC report (to include method blanks, blank/spikes, and continuing calibration checks).

#### **9.3.1 EPA Data Qualifiers**

For all analytical reports, EPA defined laboratory data flags will be required.

The seven EPA-defined data flags for organics analysis are:

- U -** Indicates element was analyzed but not detected. Report as the Contract Required Quantitation Limit (CRQL). The CRQL must be reported upon the basis of dilutions made (and percentage moisture for soils).
- J -** Indicates an estimated value. A value less than CRQL but greater than Method Detection Limit (MDL) is reported. The CRQL must be adjusted for dilutions made.
- B -** The compound was detected in the blank as well as the sample.



- E - Compounds identified whose concentrations exceed the calibrated range of the instrument receive this flag. When the sample is diluted and reanalyzed and compounds found in the original analysis are diluted out, both results are reported on separate analytical reports.
- D - Identifies all compounds quantified when a sample has been diluted and reanalyzed.
- X - Other flags may be required to properly qualify the results for a specific situation. The flag selected must be clearly defined in the Case Narrative. (If more than five qualifiers are required for a sample, use the "X" to flag to combine several other qualifiers and explain it in the Case Narrative. The combination of flags "BU" or "UB" is prohibited because the B flag is used only if the compound is found in the sample.)

The nine EPA defined data flags for inorganic analysis are:

- B - Reported value was obtained from a reading that was less than the contract required detection limited (CRDL) but greater than or equal to the instrument detection limit (IDL).
- U - Analyte was analyzed for but not detected.
- E - The reported value is estimated because of the presence of interference.
- M - Duplicate injection precision was not met.
- N - Spiked sample recovery was not within control limits.
- S - The reported value was determined by method of Standard Addition (MSA).
- W - Post-digestion spike recovery for furnace AA analysis is out of control limits while the sample absorbency is less than 50% of the spike absorbency.
- \* - Duplicate analysis is not within control limits.
- + - Correlation coefficient for MSA is less than 0.995.

#### 9.4 Overall Data Quality Assessment

A qualitative and quantitative assessment of the quality of soil and water analytical data from the investigation conducted at the Massachusetts Military Reservation will be conducted to assess the quality control and data validation procedures. A discussion of data quality in terms of precision, accuracy, representativeness, comparability, and completeness will be included in the overall assessment process. Performance evaluation (PE) sample results will be evaluated as well as a summary of the overall usability of the analytical data as determined by this data quality assessment.



## 10.0 PERFORMANCE AND SYSTEM AUDITS

### 10.1 External Audits

Auditing of laboratories used for this project in order to assure that the laboratory is able to meet the requirements of this QAPP is the responsibility of the Oversight Committee and its contractor. Non-CLP laboratories will be audited by the Contractor early in the project so that any problems can be corrected before sample analyses are complete. A CLP Laboratory is defined as a laboratory which is currently participating in the Contract Laboratory Program (CLP) in the area of organic and/or inorganic analysis; and the analytical services provided by this laboratory is managed by the Contract Project Management Section (CPMS) of the Region I, and the Sample Management Office (SMO). All CLP laboratories will be available for an audit upon request USEPA's Technical Project Coordinator will be informed of the results of any audit within 7 days of the availability of audit findings.

### 10.2 Internal Audits

Quality assurance audits will be performed by the Project Quality Assurance Officer (PQAO) or designee. The PQAO will plan, schedule, and approve system and performance audits. These audits will be implemented to evaluate the capability and performance of project and Subcontractor personnel, items, activities, and documentation of the measurement systems. At times, the PQAO may request additional personnel with specific expertise from other project groups to assist in conducting performance audits. However, these personnel are not to have participated in nor have responsibility for the direct work associated with the performance audit. USEPA's Technical Project Coordinator will be informed of the results of any audit within 7 days of the availability of audit findings.

#### 10.2.1 System Audits

Systems audits, performed by the PQAO or his designee, will encompass evaluation of QA components to ascertain their appropriate selection and application. In addition, field and laboratory quality control procedures and associated documentation will be system audited. These audits will be performed once during the project. However, if conditions adverse to quality are detected, or if the Project Manager requests the PQAO to perform unscheduled audits, these activities will be instituted. The Systems Audit will consist of an inspection of the following procedures:

- Sampling
- Sample custody
- Sample storage and preservation
- Sample preparation
- Analytical methodology
- Data management
- Preventive maintenance
- Recordkeeping

#### 10.2.2 Performance Audits

Performance audits will be conducted periodically through the duration of the project to determine the accuracy and implementation of the QA/QC Plan. As in system audits, the PQAO or assigned alternate will exercise planned and scheduled performance audits with the understanding that unplanned audits may be implemented if requested. Performance audits will be performed after the project begins to generate data. In addition to in-house performance audits, the laboratory will also participate in inter-laboratory performance evaluation studies.



## **11.0 PREVENTIVE MAINTENANCE**

### **11.1 Preventive Maintenance Procedures**

Equipment, instruments, tools, gauges, and other items requiring preventative maintenance will be serviced in accordance with the manufacturer's specified recommendation. A typical maintenance schedule for major instrumentation is provided in Table 11-1. A schedule for specific equipment operated by the laboratory will be provided in this QA/QC Plan after the laboratory subcontractor(s) has(have) been selected. In the absence of any manufacturer's recommended maintenance criteria, a maintenance procedure will be developed by the operator based upon experience and previous use of the equipment.

### **11.2 Schedules**

Manufacturer's procedures identify the schedule for servicing critical items in order to minimize the downtime of the measurement system. It will be the responsibility of the operator to adhere to this maintenance schedule, and to arrange necessary and prompt service as required. Service to the equipment, instruments, tools, gauges, etc. will be performed by qualified personnel.

### **11.3 Method-Specified Preventive Maintenance**

In the event that a CLP or EPA method mandates specific preventive maintenance procedures which are more frequent than that recommended by the manufacturer, the frequency required in the method will be followed.

### **11.4 Records**

Logs will be established to record maintenance and service procedures and schedules. All maintenance records will be documented and traceable to the specific equipment, instruments, tools, and gauges.

Records produced for laboratory instruments will be reviewed, maintained, and filed by the operators at the laboratories, and by field personnel for equipment, instruments, tools, and gauges which are used at the site. The project QA officer will audit these records to verify complete compliance with these procedures.

### **11.5 Spare Parts**

A list of critical spare parts will be requested from the manufacturer and/or identified by the operator. These spare parts will be acquired and maintained use in order to reduce downtime.



## GENERAL ANALYTICAL INSTRUMENTATION

|                            | Furnace | Flame AA | UV-VIS Spectro-Photometer | IR Spectro-meter | DI Water System | Balances | pH Meter |
|----------------------------|---------|----------|---------------------------|------------------|-----------------|----------|----------|
| Cleaning Nebulizer         |         | D,A      |                           |                  |                 |          |          |
| Clean Capillaries          |         | D,A      |                           |                  |                 |          |          |
| Drain Burner Head          |         | D,A      |                           |                  |                 |          |          |
| Clean Burner Head          |         | D,A      |                           |                  |                 |          |          |
| Cleaning Contact Cylinders |         | D,A      |                           |                  |                 |          |          |
| Changing Graphite Tubes    |         | D,A      |                           |                  |                 |          |          |
| Cleaning Furnace Windows   |         | D,A      |                           |                  |                 |          |          |
| Changing Contact Cylinders |         | W,A      |                           |                  |                 |          |          |
| Check Lamp Alignment       |         |          |                           | D,A              |                 |          |          |
| Check Fan Exhaust          |         |          |                           | D,A              |                 |          |          |
| Clean Windows              |         |          |                           | Q,S              | Q,I             |          |          |
| Clean Sample Cell          |         |          |                           |                  | D,A             |          |          |



|  | Furnace | Flame AA | UV-VIS Spectro Photometer | IR Spectro-meter | DI Water System | Balances | pH Meter |
|--|---------|----------|---------------------------|------------------|-----------------|----------|----------|
| Check Gas Leak                               |         |          |                           | D,A              |                 |          |          |
| Clean Pan                                    |         |          |                           |                  |                 | D,A      |          |
| Replace Light Bulb                           |         |          |                           |                  |                 | Y,S      |          |
| Adjust Scale Deflection                      |         |          |                           |                  |                 | Y,I      |          |
| Check with Class "S" wts                     |         |          |                           |                  | M               |          |          |
| Refill Electrodes                            |         |          |                           |                  |                 |          | W,S      |
| Clean Electrodes                             |         |          |                           |                  |                 |          | D,A      |
| Check 3rd Wire Leakage                       | Y,I     | Y,I      | Y,I                       | Y,I              | Y,I             |          | Y,I      |
| Check: conductivity, pH, and Bacteriological |         |          |                           |                  | B               |          |          |
| Check metals (6)                             |         |          |                           |                  | A               |          |          |



## GENERAL ANALYTICAL INSTRUMENTATION

|                             | Pumps | DI Water System | UV-VIS Spectro-meter | I.R. Spectro-photometer | Balances | pH Meter |
|-----------------------------|-------|-----------------|----------------------|-------------------------|----------|----------|
| Cleaning                    | B     |                 |                      |                         |          |          |
| Check Conductivity          | E     |                 |                      |                         |          |          |
| Check pH                    | E     |                 |                      |                         |          |          |
| Check for metals (6)        | A     |                 |                      |                         |          |          |
| Check for residual chlorine | M     |                 |                      |                         |          |          |
| Check bacteriological       | E     |                 |                      |                         |          |          |
| Check Fan Exhaust           |       | D,A             |                      |                         |          |          |
| Clean Windows               |       | Q,S             |                      | Q,I                     |          |          |
| Clean Sample Cell           |       |                 |                      | D,A                     |          |          |
| Check Gas Leak              |       |                 |                      | D,A                     |          |          |
| Clean Pan                   |       |                 |                      |                         | D,A      |          |
| Replace Light Bulb          |       |                 |                      |                         | Y,S      |          |
| Adjust Scale Deflection     |       |                 |                      |                         | Y,I      |          |
| Check with Class "S" wts    |       |                 |                      |                         | M        |          |
| Refill Electrodes           |       |                 |                      |                         |          | W,S      |
| Clean Electrodes            |       |                 |                      |                         |          | D,A      |
| Check 3rd Wire Leakage      | Y,I   | Y,I             | Y,I                  | Y,I                     | Y,I      | Y,I      |



## GENERAL ANALYTICAL INSTRUMENTATION

|                               | Gas Chromatograph | Purge and Trap Connector |
|-------------------------------|-------------------|--------------------------|
| Replace the Septum            | W,A*              |                          |
| Replace the Column            | Q,A*              |                          |
| Clean Injection Port          | M,A*              |                          |
| Clean Detector                | M,A*              |                          |
| Clean GC Syringes             | D,A               |                          |
| Replace Fan Purifier          | Q,S               |                          |
| Check Gas Supply              | D,S               |                          |
| Check Elect. Parts of Systems | Y,I               | Y,I                      |
| Check 3rd Wire Leakage        | Y,I               | Y,I                      |
| Check for Leaks               | D,A               | D,A                      |
| Change Purge Assembly         |                   | W,A                      |
| Change Trap                   |                   | Q,A                      |
| Check Trap Fan                |                   | W,A                      |



## GENERAL ANALYTICAL INSTRUMENTATION

|                               | Gas Chromatograph/Mass Spectrophotometer | Purge and Trap Connector |
|-------------------------------|--|--------------------------|
| Replace the Septum            | W,A*                                     |                          |
| Replace the Column            | Q,A*                                     |                          |
| Clean Injection Port          | M,A*                                     |                          |
| Clean Detector                | M,A*                                     |                          |
| Clean GC Syringes             | D,A                                      |                          |
| Replace Fan Purifier          | Q,S                                      |                          |
| Check Gas Supply              | D,S                                      |                          |
| Check Elect. Parts of Systems | Y,I                                      | Y,I                      |
| Check 3rd Wire Leakage        | Y,I                                      | Y,I                      |
| Check for Leaks               | D,A                                      | D,A                      |
| Change Purge Assembly         |  | W,A                      |
| Change Trap                   |  | Q,A                      |
| Check Trap Fan                |  | W,A                      |
| Clean Source                  | * ,S                                     |                          |
| Alignment of Source           | * ,S                                     |                          |
| Vacuum Pump                   | * ,A                                     |                          |



## GENERAL ANALYTICAL INSTRUMENTATION

|                          | Inductively Coupled Plasma | Database Update |
|--------------------------|----------------------------|-----------------|
| Check/Change Pump Tubing | W,A                        |                 |
| Cleaning/Changing Torch  | * ,A                       |                 |
| Filters                  | M,A                        |                 |
| Update IECs              |                            | Q,A             |
| Update Linear Ranges     |                            | Y,A             |



## GENERAL ANALYTICAL INSTRUMENTATION

|                             | Pumps | DI Water System | UV-VIS Spectro-Photometer | I.R. Spectro-photometer | Balances | pH Meter |
|-----------------------------|-------|-----------------|---------------------------|-------------------------|----------|----------|
| Cleaning                    | B     |                 |                           |                         |          |          |
| Check conductivity          |       | E               |                           |                         |          |          |
| Check pH                    |       | E               |                           |                         |          |          |
| Check for metals (b)        |       | A               |                           |                         |          |          |
| Check for residual chlorine |       | M               |                           |                         |          |          |
| Check bacteriological       |       | E               |                           | D,A                     |          |          |
| Check Fan Exhaust           |       |                 |                           |                         |          |          |
| Clean Windows               |       | Q,S             | Q,I                       |                         |          |          |
| Clean Sample Cell           |       |                 | D,A                       |                         |          |          |
| Check Gas Leak              |       |                 | D,A                       |                         |          |          |
| Clean Pan                   |       |                 |                           | D,A                     |          |          |
| Replace Light Bulb          |       |                 |                           | Y,S                     |          |          |
| Adjust Scale Deflection     |       |                 |                           | Y,I                     |          |          |
| Check with Class "S" wts    |       |                 |                           | M                       |          |          |
| Refill Electrodes           |       |                 |                           |                         | W,S      |          |
| Clean Electrodes            |       |                 |                           |                         | D,A      |          |
| Check 3rd Wire Leakage      |       | Y,I             | Y,I                       | Y,I                     | Y,I      |          |



## THERMAL AND MECHANICAL DEVICES

|   | Sample Standard Ref. | Cooling System | Ovens Incubator s | Hot Plates Digestors Dry Baths | Stirrers Shakers Centrifuges | Heating Mantels/C ontrollers | Stills | Flash Point Tester | General Purpose Vacuum Pumps | Main Air Compress or |
|---|----------------------|----------------|-------------------|--------------------------------|------------------------------|------------------------------|--------|--------------------|------------------------------|----------------------|
| Check all Operational Indicators              | D,A                  | D,A            | D,A               | E,A                            | E,A                          | E,A                          | E,A    | E,A                | E,A                          |                      |
| Check Output Temp.                            | D,A                  | D,A            | D,A               | E,A                            |                              | D,A                          |        |                    |                              |                      |
| Clean Condenser Coils                         | Q,A                  |                |                   |                                |                              |                              |        |                    |                              | M,I                  |
| Check Thermally Exposed Connections and Wires | Y,I                  | BY,I           | BY,I              | Y,I                            | BY,I                         | BY,I                         | BY,I   | BY,I               | BY,I                         |                      |
| Check 3rd Wire Leakage                        | Y,I                  | Y,I            | Y,I               | Y,I                            | Y,I                          | Y,I                          | Y,I    | Y,I                | Y,I                          |                      |
| Check Fluid Level                             |                      | D,A            |                   |                                |                              |                              | D,A    | D,A                | D,A                          | D,A                  |

**Key:**

E = Each Use

D = Daily

W = Weekly

M = Monthly

Q = Quarterly

Y = Yearly

B = Prefix of BI (twice per period)

\* = As needed, but not longer than otherwise specified

A = Analyst

S = Supervisor

I = Instrumentation Specialist



## 12.0 SPECIFIC ROUTING PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

Procedures used to assess data precision and accuracy will be in accordance with 44 CFR 69533 "Guidelines Establishing Test Procedures for the Analyses of Pollutants," Appendix III "Example Quality Assurance and Quality Control Procedures for Organic Priority Pollutants," December 3, 1979, and the respective analytical method, and are described in Section II "Internal Quality Control Check." Completeness is recorded by parameters successfully completed and validated. For this project a target control limit of greater than 90 percent will be used.

### 12.1 Accuracy

The percent recovery (PR) is calculated as below:

$$PR = \frac{S_s - S_o}{S_A} \times 100$$

$S_o$  = background value; e.e., value obtained by analyzing the sample

$S_A$  = concentration of the spike added to the sample.

$S_s$  = value obtained by analyzing the sample with the spike added.

PR = percent recovery

### 12.2 Precision

The relative percent difference (RPD) is calculated as below:

$$RPD = \frac{|S - D|}{\frac{1}{2}(S + D)} \times 100$$

where:

$S$  = Concentration of analyte in first (original) sample (mg/kg or  $\mu$ g/l); and

$D$  = Concentration of analyte in second (duplicate) sample (mg/kg or  $\mu$ g/l).

### 12.3 Completeness

The percent complete (PC) is calculated as follows:

$$PC = \frac{N_A}{N_I} \times 100$$

$N_A$  = actual number of valid analytical results obtained.

$N_I$  = theoretical number of results obtainable under ideal conditions.



## 13.0 CORRECTIVE ACTION

The following procedures have been established to assure that conditions adverse to quality including malfunctions, deficiencies, deviations, and errors are promptly investigated, documented, evaluated, and corrected. Corrective actions are included in the summary of quality control activities in Table 6-1 of the QA/QC Plan.

### 13.1 Initiation of Corrective Action

When a significant condition adverse to quality is noted at the project site, laboratory, or subcontractor locations, the cause of the condition will be determined and corrective action taken to preclude repetition. Condition identification, cause, reference documents, and corrective action planned to be taken will be documented and reported to the Project Manager, PQAO, Field Team Leader, and involved Subcontractor management, as a minimum. Implementation of correction action will be verified by documented follow-up action. All project personnel have the responsibility, as part of their normal work duties, to promptly identify and report conditions adverse to quality, and solicit correction.

Corrective actions may be initiated, as a minimum:

- When predetermined acceptance standards are not attained (objectives for precision, accuracy, and completeness);
- When procedures or data compiled are determined to be incorrect or incomplete;
- When equipment or instrumentation is found to be malfunctioning;
- When samples and test results cannot be traced with certainty;
- When quality assurance requirements have been violated;
- When designated approvals have been circumvented;
- As a result of system and performance audits;
- As a result of a management assessment; or
- As a result of laboratory/inter-laboratory comparison studies.

### 13.2 Procedure Description

Project management and staff, including field investigation teams, quality assurance auditors, document, and sample control personnel, and laboratory groups, will monitor ongoing work performance in the normal course of daily responsibilities. Work will be audited at the site, laboratories, and Subcontractor locations by the PQAO or his designee, by NGB QA personnel, and/or by QA personnel in the State of Massachusetts or USEPA. Items, activities, or documents ascertained to be in noncompliance with QA requirements will be documented and corrective actions mandated through the audit report. Corrective actions will be logged, maintained, and controlled by the PQAO.

Following identification of an adverse condition or quality assurance problem, notification of the deficiency will be made to the Program Manager, the Project Manager, and the senior individual in charge of the activity found to be deficient, along with recommendations for correction. A record of this notification will be attached to the audit report. Following implementation of corrective action, the senior individual in charge will report actions taken and results to the Project Manager and the PQAO. The PQAO will notify the



Program Manager when conditions adverse to quality have been corrected. A record of action taken and results will also be attached to the audit report.

### **13.3 Variance Documentation**

Any deviation from project requirements as specified in this document or the Statement of Work requires proper documentation using a Field Change Request Form (13.1). This form will be completed in the field by the Field Team Leader and forwarded to the Contracting Officer Representative (COR) by the most expedient communications means available. Upon receipt, the COR will review and indicate final disposition of the request and return the original document to the originator. A copy of the document should be retained for the project file. Changes that require an immediate response will be initiated by telephone or other telecommunication transmission, and then documented using the procedure described above.



## **14.0      QUALITY ASSURANCE REPORTS**

Quality assurance reports to management consists of the reports on audits, reports on correction of deficiencies found in audits, a final QA report on field sampling activities, and a final analytical laboratory QA/QC report.

### **14.1    Field QA Audits**

The mobilization stage will be audited before work begins to assure that all procedures, training, and materials are ready to support the QA Plan. Field activities may be audited during operation in order to assure compliance with the QA Plan. Additional audits may be required depending on the results of these audits. All audits and corrective actions will be reported in writing to the Program Manager and the Project Manager.

### **14.2    Analytical Laboratory QA/QC Reports**

The laboratory will provide reports of their QA/QC program and results to the Project Manager at the completion of this investigation. These reports and a summary of the laboratory QA/QC program and results will be included in the final project report.



## REFERENCES

EPA, "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans", February, 1983

CDM Federal Programs Corporation, "Quality Assurance Project Plan for Field Investigation at Massachusetts Military Reservation" June, 1993

CDM Federal Programs Corporation, "Quality Assurance Plan for Hazardous Waste Remedial Action Programs" January, 1992

EPA, "Guidance for conducting Remedial Investigations and Feasibility Studies Under CERCLA-Interim Final" 1988

Department of Energy, "Requirements for Quality Control of Analytical Data", July 1990

Department of Energy, "Standard Operating Procedures for Site Characterization", July 1990

EPA, "Region I New England Data Validation Functional Guidelines for Evaluation of Environmental Analyses", December, 1996

EPA, "Region I Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses", February, 1989

USEPA, "Contract Laboratory Program National Functional Guidelines for Inorganic Data Review", February, 1994

USEPA, "Contract Laboratory Program National Functional Guidelines for Organic Data Review", February, 1994

USEPA, "Contract Laboratory Program Statement of Work for Organic Analysis of Low Concentration Water" OLC02.1, February, 1996

USEPA, "Contract Laboratory Program Statement of Work for Organic Analysis, Multi-Media, Multi-Concentration" OLM03.2, 1996

USEPA, "Contract Laboratory Program Statement of Work for Inorganic Analysis, Multi-Media, Multi-Concentration" ILM04.0, 1995

USEPA, "Test Methods for Evaluating Solid Waste Physical/Chemical Methods", SW-846, 3rd Edition . November, 1986

Standard Methods for the Examination of Water and Wastewater; APHA-AWWA-WPLF, 17th Edition, 1989.



## **APPENDIX-B**

### **Response to Comments**



EPA COMMENTS ATTACHED TO LETTER OF JULY 3, 1997  
**(responses in bold)**

ATTACHMENT A

General Modifications

Surface and subsurface soil sampling and analysis, monitoring well installation, and other sampling and analysis will be performed according to the following procedures:

(A) Surface soil sampling procedures-- a focal area or areas of concern will be identified for each target area/site to be sampled. The target areas/sites include, at a minimum, those specified in EPA's May 8, 1997 correspondence between Jane Dolan, EPA Technical Project Coordinator and Colonel William Crocker and Mr. Gerard Winters of the National Guard Bureau. Each focal area or areas of concern will be marked with one or more 30-foot square grids. A minimum of five (5), 30-foot square grids for each acre of a given focal area will be required. For the gun and mortar positions of "high-use," "low-use" and "mixed-use," the one-acre focal area would encompass both the firing area and bag burning area at that particular position. In addition to the focal areas, "control" areas will be randomly identified at locations which are not believed to be within the immediate target area(s) of concern. There will be four (4) control areas within the Impact Area, and two (2) control areas for the gun and mortar positions. For each 30-foot square grid, soil samples will be collected at 10-foot spacings (nine samples per grid per depth). Each grid point will be sampled at the 0-6" and 18-24" interval below the ground surface, and a composite of the 0-6" and 18-24" sample will be obtained for analysis. The compositing procedure will be specified in an attachment to the Final Action Plan.

**Section 4.0 of the Action Plan has been modified to incorporate these sampling procedures.**

(B) Surface soil sampling analysis -- Each of the 0-6" and 18-24" composite soil samples will be analyzed for explosives (colorimetric) and inorganics. Volatile organics (VOCs) analysis will be conducted on individual grab sample(s); the specific sample(s) to be analyzed for VOCs will be selected based on screening results using a flame ionization detector (FID). The 0-6" composite soil sample will also be analyzed for all other analytes (e.g., semi-volatile organics, pesticides/PCBs and herbicides). Any composite soil sample obtained from within the Impact Area that shows detectable levels of explosives using colorimetric methods will be analyzed using EPA Method 8330. Overall, 10% of all samples (obtained from within and outside the Impact Area) that show detectable levels of explosives and 5% of all samples showing no detectable levels of explosives will be analyzed using EPA Method 8330. Any 0-6" composite soil sample that shows detectable levels of any other analyte (i.e., semi-volatile organic, pesticide, PCB or herbicide) will result in the corresponding 18-24"



composite soil sample undergoing further analysis for that particular analyte group(s) which showed a detectable concentration.

**Section 4.0 of the Action Plan has been modified to incorporate these sampling procedures.**

(D) Other surface soil sampling requirements -- EPA requires that the Final Action Plan provide a sampling methodology/strategy for defining "background" concentrations in soil.

**NGB proposes to obtain surface soil samples for determining background concentrations of metals, pesticides, herbicides and polynuclear aromatic hydrocarbons, to be used in selecting Constituents of Potential Concern for human and ecological risk assessment. Ten soil samples will be collected from a location off the post that is unimpacted by known releases of hazardous waste. NGB proposes that the samples be collected from the trail areas of the Shawme Crowell State Forest. Samples will be taken from the top 0-6 inches of soil.**

**Samples will be analyzed by the following methods and reported at the same DQO level required for site sampling.**

|  |                           |
|--|---------------------------|
| <b>Metals</b>                            | <b>ILM04</b>              |
| <b>Pesticides</b>                        | <b>OLM03.2</b>            |
| <b>Polynuclear Aromatic Hydrocarbons</b> | <b>OLM03.2</b>            |
| <b>Herbicides</b>                        | <b>SW-846 Method 8151</b> |

The IRP Program currently has background levels of metals summarized in the MMR Risk Assessment Handbook. NGB will review the underlying data for this summary in order to evaluate whether these samples may be used to supplement the background dataset. Acceptance criteria will be that samples must have been obtained from areas with no known releases of hazardous materials from MMR or other recognized release sites; and have been sampled using the same methods and QA/QC requirements as other surface soil samples obtained for the Impact Area Study. The background dataset will be used to establish a background threshold for screening. The background threshold will be the upper 90th percentile on the distribution of background samples.

This proposal, if acceptable to EPA, will be implemented through preparation of a Field Sampling Plan attachment to the Action Plan, and data will be presented and incorporated in the Risk Assessment Work Plan.

EPA also requires that the Final Action Plan contain a discussion regarding the performance objectives for evaluating/correlating the colorimetric versus EPA Method 8330 explosives results before sampling, with subsequent evaluations and comparisons to the stated performance objectives. Conditions which need to be considered in the evaluation/correlation discussion are: (a) both methods indicate non-detect concentrations; (b) one method indicates a detect and the other a non-



detect concentration; and (c) both methods report a detectable concentration. Comparability criteria need to be established for each condition with, if necessary, corrective actions (including resampling) specified. The correlation needs to be established early in the program and verified.

**A discussion of performance objectives has been added to Section 4.0 of the Action Plan.**

(E) Subsurface soil sampling and analysis procedures during Groundwater Monitoring Well Installations -- EPA requires that, at each of the boring locations for groundwater monitoring well installation, subsurface soil sampling occur at 10-foot intervals within the Impact Zone and Buffer Zone, as well as outside the Buffer Zone. From the first, 10-foot sample interval obtained from within the Impact Zone and within the Buffer Zone, EPA requires that a 0-6" and 18-24" surface soil grab (not a composite) sample be taken and analyzed and specified in (B) above. In addition, from the first, 10-foot sample, a subsurface soil sample will be obtained from the 8-10 foot interval and analyzed for explosives (colorimetric), inorganics and all other target analytes. From the second, 10-foot sample, a subsurface soil sample will be obtained from the 18-20 foot interval and analyzed for explosives (colorimetric) and inorganics. Any detectable concentrations of explosives from the colorimetric analysis of these two samples will be further analyzed by EPA Method 8330. If no detectable levels of explosives are identified from the 8-10 foot or 18-20 foot sample intervals, no further analysis will be required of the archived samples taken already from the lower 10-foot sample intervals up to the water table. Subsurface soil samples obtained from locations outside the Buffer Zone will be obtained and analyzed as specified in the current Draft Final Action Plan.

**Section 4.0 of the Action Plan has been modified to incorporate these sampling procedures.**

(F) Bedrock coring during groundwater monitoring well installation -- EPA requires that confirmation of bedrock be performed at each of the bedrock wells by coring into bedrock a minimum of 15-feet at each deep location. The NGB will also utilize the USGS bedrock map of the study area to further verify that refusal is indeed "bedrock" refusal and not just a boulder or other obstruction.

**Section 4.0 of the Action Plan has been modified to incorporate these sampling procedures.**

(G) Groundwater sampling procedures during monitoring well installation -- EPA requires that a GC be used to screen for volatile organics (in addition to explosives) from those 10-foot groundwater samples obtained during, at a minimum, the monitoring well installation program within the requested source/target areas in the Impact Zone and Buffer Zone. It is required that either the GC analysis be performed concurrent with the explosives analysis being performed off-site or through arrangements with the IRP lab at the base.



**Section 4.0 of the Action Plan has been modified to incorporate these sampling procedures.**

(H) Groundwater Monitoring Well sampling procedures from well screens installed-- EPA requires that the entire first round of groundwater monitoring well samples be analyzed for all target compounds (VOCs, SVOCs, pesticides/PCBs, herbicides, EDB, MTBE, explosives and TAL inorganics (unfiltered only)) using EPA Region I low-flow purge and sampling procedures. These analysis must also incorporate the degradation and combustion byproducts of explosives and propellants.

**Section 4.0 of the Action Plan has been modified to incorporate these sampling procedures. NGB will analyze filtered samples and unfiltered samples for inorganics.**

(I) Surface water and Sediment sampling procedures -- EPA requires that Deep Bottom Pond, Donnelly Pond and Little Halfway Pond be added to the Final Action Plan for characterization (including possible herbicide contamination from runoff into these areas), and that Raccoon Swamp be used as a “control” location for these media. EPA requests that these ponds/swamp be sampled and analyzed for soils or sediments with or without the presence of surface water within these areas.

**These areas have been added to the list of areas to be investigated in Section 3.0 of the Action Plan.**

The Final Action Plan must be updated to reflect all comments received on the prior Draft Action Plan documents, and must also contain the detailed field sampling plans describing the individual surface soil, subsurface soil, groundwater, and surface water sediment procedures in detail. This will ensure that field sampling crews, oversight parties, and the public will be able to accurately follow the process.

**NGB believes that this Final Action Plan is responsive to previous comments on the Draft and Draft Final Action Plans. Responses to comments that were inadvertently left out of the last version of this document are contained in the current version. Detailed sampling procedures largely consist of the MMR SOPs, as described in Section 4.0, and these are being incorporated by reference rather than reproduced.**

It is required that the Final Action Plan be organized according to the target areas/sites of concern, and the Plan must clearly differentiate between monitoring wells inside and outside of the Impact Zone, Buffer Zone and Training Range. Each section should clearly describe the rationale for sampling each medium (water, soil, sediment), the sampling interval, screening method, analysis parameter, analysis method, and number of samples to be collected. Several tables are required in the Final Action Plan which summarize each individual target area/site and which support the discussion provided in the text. Finally, a master table of all target areas/sites for all parameters should be developed from the individual tables to summarize the overall program.



**The organization of the Action Plan has been modified in order to provide a clearer description of the investigation of each area of concern. The revised Section 4.0 contains general descriptions of investigation procedures, and a specific Field Sampling Plan (FSP) is being developed for each area of concern as a stand-alone attachment to the Action Plan. FSPs for several areas of concern have already been developed and are being submitted with the Final Action Plan. FSPs for the remaining areas of concern are under development and will be submitted to EPA for review over the next few weeks.**

In the Final Action Plan, EPA requires that an SOP be provided for radiation monitoring/instrumentation and a description of the radiological survey that will be proposed, in addition to the sampling protocol.

**The MMR SOP for radiological surveys is referenced in Section 4.0. Details of the survey type(s) and area(s) will be provided in the relevant FSPs.**

The Final Action Plan needs to ensure that all laboratory data will include all the required information needed to perform a Tier III validation, if deemed necessary at a later date.

**The QA/QC Plan indicates that data deliverables will be sufficient for Tier III validation.**

The Final Action Plan must include statements that the field sampling personnel and analytical laboratory will have sufficient training and experience with explosive sampling and analysis.

**Explosive wastes will not be sampled or analyzed for this study. Environmental media (e.g., soil) contaminated with explosives are not expected to present an explosion hazard based on the relatively dilute concentrations of explosive compounds that have been encountered at similar locations.**

The May 16, 1997 Draft Response to Comments II indicates that the following information will be contained in the Archives Search report: all data relating to the construction details and water quality results of all current and potential water supply wells, including, but not limited to, the ASP building, Range Control building, Cape Cod AFS, USCG transmitter station, and Textron. Please confirm this fact within the Final Action Plan.

**The text in Section 3.1.1 has been revised to indicate that this information will be included.**

The NGB must correct or clarify unsupported statements in the Draft Final Action Plan as identified in comments received from the Impact Area Review Team.

**See responses to comments from the Impact Area Citizen Review Team.**

#### Specific Modifications

1. Section 1.3, pg 6, par 1 - Change LRWS PAT to Impact Area Review Team.  
Additionally, state in the Plan that the one of the objectives of the investigation is to



identify potential source areas of ground water contamination through surface and subsurface soil sampling.

**The requested changes have been made.**

2. Section 1.3, pg 6, par 2 - State in the Plan that the study will include a thorough investigation of suspected potential sources based upon archives search, interviews, and other means, and by surface and subsurface soil sampling and groundwater monitoring.

**The requested changes have been made.**

3. Section 1.4, pg 8, par 2 - Please enumerate the other activities of potential environmental concern. Provide supporting references for the as of yet unqualified statements concerning PEP transformation.

**A paragraph listing other activities of potential concern has been added. The text has been revised to indicate that the PEP components are designed to be completely consumed. *Almost completely destroyed* and *most* of the explosion in a HE projectile are destroyed at impact accurately reflect the design purpose of explosives.**

**Explosives improvements have sought quick and complete consumption of compounds to produce a greater explosive effect per given weight of ammunition. Firing units monitor ordnance which does not produce a full explosive functioning effect. These ordnance are tested to determine if manufacturing or transportation/storage abnormalities have reduced their effectiveness. If so, entire lots of ammunition are withdrawn from service and destroyed or returned for manufacturing correction. The signal marking component of the LITR more accurately meet the description of a pyrotechnic than an explosive. Compounds in signal charges are a part of the study.**

4. Section 2.1, pg 10, par 1 - State in the Plan that the primary focus of the investigation is past, present and future activities at and in the vicinity of the Training Range and Impact Area.

**The requested change has been made.**

5. Figure 2-2 - Label and locate all surface water bodies at and in the vicinity of the Training Range and Impact Area. In addition, the gun and mortar positions do not correlate with those identified on the August 1994 Camp Edwards Special Map Series V814S, Edition 1-30-ETB. This must be corrected/clarified.

**The requested change has been made.**

6. Section 2.2, pg 13, par 1 - State in the Plan that the study area is the area in and near the Training Range and Impact Area. Please provide any information relating to wastewater disposal at Textron and PAVE PAWS.

**The requested change regarding the study area has been made. No information is currently available relating to wastewater disposal at Textron or PAVE PAWS. This information will be requested for inclusion in the Range Use History Report.**



7. Figure 2-7 - Locate FS-14 and the geographic extent of each range. Refer to the Summary of Range Activities located within the current Draft Range Use History Report. **FS-14 has been added to Figure 2-7. The geographic extents of the ranges are currently under investigation and will be documented in the Range Use History Report.**

8. Figure 2-8 - A map locating all identified potential source/target areas (not just the most persistent areas identified) must be provided within the Final Action Plan. Identified potential source areas to date include those specified in EPA correspondence of May 8, 1997. As additional sources are identified, addendums to the Final Action Plan which describe the locations, actions to be implemented at each area, and schedule are to be provided to EPA for review and approval. Some of these additional sources include: the mortar fire impact area in the vicinity of Suconsette Pond, tower at Range Control, chemical warfare training area, gravity anti-tank range, all bivouac and/or maneuver areas, and the power transmission lines and fire lanes.

**Figure 2-8 identifies areas of interest that NGB and EPA have agreed on for characterization as potential source areas, based on meetings and correspondence over the last six months. Other areas of interest are being identified in the Archive Search task that is described in Section 3.1.1 of the Action Plan. It is premature to suggest that these other areas are potential sources of groundwater contamination, until the results of the Archive Search are available. NGB agrees that for any additional potential sources that are identified, field sampling plans will be prepared that include locations and actions to be implemented.**

9. Section 2.4.3, pg 38, par 2 - Please provide a description of the UXO survey activities which will be utilized to determine the density of fragmented munitions as well as the extent of the affected area for each potential source/target area.

**The description of UXO surveys in Section 3.1.3 has been revised to address this comment, and a reference to this description has been added to the text.**

10. Section 3.0, pg 41 - Assign consistent identifiers to ranges and other site features, potential source/target areas, wells, and other sampling locations. Provide several map(s), not simply one cluttered map, locating these features on a smaller, more detailed scale than currently presented.

**Location identifiers and detailed sampling maps are being provided in the Field Sampling Plans as described in Section 4.0. This level of detail is not appropriate for Section 3.0, which provides an overview of the proposed investigations.**

Additionally, the application of the IRP database for background comparison purposes is not acceptable. The NGB is required to develop a background sampling and analytical protocol for soils, groundwater, surface water and sediment, and provide this within the Final Action Plan. The NGB must identify unimpacted areas (preferably off-base) that are similar in characteristic to base media, for background sampling locations. At a minimum, inorganics, pesticides and herbicides must be included in the analysis.



NGB has proposed to develop a background database for soils (see response to General Modification D). NGB would like further clarification of why EPA feels the IRP database is not acceptable, at least as a supplement to this information. We agree that this database is not complete in that EPA has requested background sampling for herbicides and pesticides, which are not included in the database. Additionally, we have no information as to the sampling locations, analytical methods, or level of QA/QC applied to the IRP samples. However, if the acceptance criteria outlined in our response to General Modification D are met, it is unclear what EPA's objection to the these samples are.

NGB will use the following methods to establish a background database for groundwater, surface water and sediment. For groundwater, a difficulty exists in that the Impact Area is generally a groundwater high such that most on-post locations could be construed as downgradient of the study area. Thus, to find groundwater wells that would serve as acceptable groundwater references, it may be necessary to move away from the post, to areas not associated with plumes from MMR or other release sites. NGB proposes to confer with IRP to identify offsite wells known to be outside plume areas. An appropriate area for this evaluation could be wells near or to the south of Route 151, as this is an area generally thought to be beyond delineated plumes. If no wells in the IRP net are sufficiently beyond potentially impacted areas, new wells will be installed to the south of Route 151 to serve as background wells. Wells will be sampled and analyzed for metals, herbicides, and pesticides using the following methods. Reporting will be at the same DQO level required for Impact Area analyses:

|            |                    |
|------------|--------------------|
| Metals     | ILM04              |
| Pesticides | OLM02.1            |
| Herbicides | SW-846 Method 8151 |

The establishment of a background threshold for groundwater will be the 90th percentile value of the distribution of background results.

NGB proposes to determine background for metals, herbicides, and pesticides in surface water and metals, herbicides, pesticides, and polynuclear aromatic hydrocarbons in sediment samples collected from EPA's proposed control location, Racoon Swamp. Ten samples of surface water and sediment will be collected from this waterbody, using sampling techniques specified for all other surface water and sediment sampling in the Action Plan. Surface water samples will be analyzed for metals, herbicides, and pesticides using the following methods, and reporting will be at the same DQO level required for Impact Area Sampling:

|            |                    |
|------------|--------------------|
| Metals     | ILM04              |
| Pesticides | OLM02.1            |
| Herbicides | SW-846 Method 8151 |



**Sediment samples will be analyzed for metals, herbicides, pesticides and polynuclear aromatic hydrocarbons using the following methods, and reporting will be at the same DQO level required for Impact Area Sampling:**

|  |                           |
|--|---------------------------|
| <b>Metals</b>                            | <b>ILM04</b>              |
| <b>Pesticides</b>                        | <b>OLM03.2</b>            |
| <b>Polynuclear Aromatic Hydrocarbons</b> | <b>OLM03.2</b>            |
| <b>Herbicides</b>                        | <b>SW-846 Method 8151</b> |

**Screening threshold for background will be the 90th percentile value of the distribution of background results.**

**This proposal, if acceptable to EPA, will be implemented through preparation of a Field Sampling Plan attachment to the Action Plan, and data will be presented and incorporated in the Risk Assessment Work Plan.**

11. Section 3.0, pg 42 and Figure 3-1 - The text and Figure must be corrected to reflect the currently agreed upon locations of groundwater monitoring wells as reflected in the technical meeting minutes from the June 18 and June 26 at the MADEP-SERO.

Particular attention needs to paid towards the required placement of nested wells within each of the five currently identified zones of contribution to the potential long-range water supply sites # 1, 2, 3, 8, and 95-6/95-15. Additionally, three additional shallow wells are required to be installed near Site 5 and FS-12 to improve the hydrogeological (and possible chemical) information in this area which is near the top of the water table mound on MMR.

**The requested changes have been made.**

12. Section 3.0, pg 43, par 1 - Please identify each of the 18 IRP wells discussed herein, and provide a single map of same.

**The IRP wells for sampling will be identified and mapped after NGB reviews and summarizes data for wells in the identified source areas. NGB proposes to provide this information in the form of a technical memorandum or Field Sampling Plan addendum to the Action Plan.**

13. Section 3.1.4.3, pg 50 - The IRP wells to be sampled for water quality are those located at sites CS-18, CS-19, FS-12, LF-1, CS-10, USCG-CS-1, PAVE-PAWS and FS-

14. Please identify on a new Figure the specific wells using either IRP or NGB nomenclature. Other wells to be sampled are those water supply wells at the Ammunition Supply Point building, Range Control building, Cape Cod AFS, USCG transmitter station and Textron.

**See the response to comment 12.**

14. Section 3.1.4.4, pg 50, par 2 - All 9 subwatershed areas are to be investigated with particular attention focused on drainage swales and/or valleys within each of the subwatershed areas. EPA requires that the “first flush” grab sample approach, stated in



the MADEP comments of June 16, 1997, be followed in the event of a major storm event (>1 inch of precipitation in 24 hours).

**The requested changes have been made.**

15. Section 3.1.5., pg 53, par 1 - Consideration should be given to the need for double cased well construction to minimize the potential for carrying down shallow contamination to deeper zones. Existing data should be reviewed to estimate the likelihood that this has occurred at existing well(s). If so, additional wells may need to be installed to confirm the hypothesis.

**The existing procedure for barber drills at MMR has been to re-use water that was used to remove sand heave from the inside of the 8" casing, in order to minimize IDW generation. The water is pulled out of a roll-off, which also contains potentially contaminated soil from previous heaves, and is pumped down the hole to remove the heave. One-time use of potable water is generally not feasible due to the remoteness of the drilling sites. In order to eliminate the water as a potential source of contamination, NGB plans to treat the water with a portable GAC system prior to reuse.**

16. Section 3.1.8, pg 55 - EPA understands that dataloggers will be installed in wells at CS-18, CS-19 and one LRWS well (please identify which wells are being considered). Each zone (shallow, intermediate, deep) must be monitored.

**NGB proposes to install dataloggers in MW-1 at CS-18, MW-1 at CS-19, and LRWS Site 2-1. The IRP wells are shallow wells, while the LRWS well is screened below the water table. Consideration will be given to relocating the dataloggers to other wells after data have been collected at these locations.**

17. Section 3.3.4, pg 58 - A long term monitoring program of water levels and quality will be instituted during the study. Additional aspects of the long term monitoring program will also be developed. The monitoring must be integrated with the ongoing IRP efforts.

**The requested changes have been made.**

18. Section 4.0, Table 4-1 - This table requires significant revision based upon the general modifications stated in Attachment A for surface soils, subsurface and groundwater analysis, and requires clearer presentation of the information in more than one table. All analytical method references need to be cited including screening methods. The footnote "InO (...)" must be changed to read "TAL metals and cyanide (plus phosphorous, nitrate/nitrite, and ammonia.)"

**Table 4-1 has been eliminated from the Action Plan, as it is not possible to specify numbers of samples until the focal areas for the potential source areas have been identified. These focal areas and numbers of samples will be identified in the specific Field Sampling Plans (FSPs) to be provided as stand-alone attachments to the Action Plan. The FSPs include tables providing sample numbers and analytes.**



19. Section 4.1.4, pg 63, par 1 - It is necessary to explicitly identify each potential source/target area and site (including depressions and swales), the areal extent of each potential source/target area and site, the areal extent of each focal area if different in size from the extent of the source/target area, and provide the basis for the focal area estimate which will be sampled. Provide a grid layout (non-overlapping) for each source/target area and site as discussed at the June 18 and June 26 technical meetings. The grid coverage is subject to EPA approval.

**The requested information is being provided in the Field Sampling Plan for each area of concern.**

20. Section 4.1.4, pg 63, par 3 - Sampling will encompass both soils in front of the firing point and a bag burning/disposal locations at each gun and mortar position.

**Section 4.0 has been revised to indicate that gun and mortar positions will be sampled at both of these types of locations.**

21. Section 4.1.4, pg 65, par 2 - Clarify the subsurface soil and ground water sampling and analytical protocol for well borings.

**Section 4.0 has been modified to include the sampling protocols specified by EPA in these comments as “General Modifications”.**

22. Section 4.1.6, par 2 - Previous inorganics sampling at MMR has shown that turbidity readings in the range of 5 to 10 NTUs can result in samples which are biased toward higher concentrations due to the presence of particulate. Redevelopment of wells not achieving low turbidity should be considered before sampling. Use of filtered metals data will not be an option for the human health risk assessment. EPA has previously indicated and insists that all groundwater samples be initially analyzed for explosives, inorganics, TCL VOCs and SVOCs, phosphorous, nitrate/nitrite, ammonia, EDB and MTBE.

Groundwater samples should also be analyzed initially for chloride (Cl), sulfate ( $\text{SO}_4$ ), bicarbonate ( $\text{HCO}_3$ ) and TOC or DOC. The text must indicate that the most volatile samples are collected first. Dissolved oxygen (DO) should be determined in the field using a colorimetric method (i.e. Hach Kit). This determination is separate from the relative measurement using a flow through cell for estimating field parameter stabilization prior to sampling, and only one determination needs to be obtained for each well sample.

**The requested revisions have been made.**

23. Section 5.2.3, pg 78 - Treated water must be analyzed before it is discharged to the ground surface.

**The treated water is analyzed at the discharge from the first GAC unit. When the analysis indicates breakthrough, the first unit will be replaced with the second unit and a new second unit installed. This is the same procedure that is used under the IRP.**



24. Section 7.1.2, pg 84 - Verify whether Ogden will prepare performance specifications for all subcontractors and whether they will be providing the subcontractors with oversight and audits to assess their performance.

**The requested changes have been made.**

25. Surface water and sediment (when present), and soils are to be collected from each surface water body in the vicinity of the Training Range and Impact Area. These areas include Bailey's Pond, Donnelly Pond, Little Halfway Pond, Racoon Swamp and Snake Pond in addition to those previously specified in the May 1997 Draft Final Action Plan. Sampling of surface water and sediment should include shoreline areas. A representative number of samples are to be collected (more than one) and all samples are to be analyzed for all constituents of concern - explosive compounds (explosives, propellants, and pyrotechnics), metals, VOCs, SVOCs, pesticides/herbicides, PCBs, EDB, and MTBE. In addition, surface water samples are to be analyzed for hardness and sediment samples analyzed for TOC. Sediment samples are to be collected such that low percent solids will not be an issue. If it is determined that the sediment samples contain low percent solids, the Region I policy will be followed (copy attached).

**The requested changes have been made.**

#### Appendix A: QA/QC Plan

26. Section 1.5, pg 2 - Method 504.1 is the correct method for water samples, not 504.2.

**The requested change has been made.**

The HAZWRAP soil/sediment method for EDB that has been used at MMR for previous investigations is recommended for soil EDB analyses.

**NGB will evaluate the performance of the HAZWRAP procedure in comparison to Method 8021, to evaluate the need for this change.**

27. Section 4.9, pg 14 - The laboratory must understand that if the VOC samples are not preserved to a pH <2, then the analyses must be performed within 7 days of sampling.

The laboratory should inform the project manager of the situation so that corrective action can be initiated. Also, EDB samples are preserved with sodium thiosulfate, not HCL.

**The text has been revised to indicate that preservation methods and other SOPs are provided in Section 4.0 of the Action Plan.**

28. Section 5.4, pg 18 - Laboratory custody procedures must include provisions for situations when all data and samples are not correct (i.e., informing the project manager when sample labels do not match the Chain-of-Custody, or sample bottles are received broken, etc...).

**The requested revision has been made.**

Table 6-1, pg 22 - The following methods need to be added to this table; SW-846 Methods 8151, Method 504.1, and the soil EDB method.



**The requested additions of Method 8151 and 504.1 have been made; see response to comment 26 regarding the EDB method.**

Table 7-1(f), pg 36 - The EDB detection limit for water samples must be below the MA MCL of 0.02 ug/l. Detection limits for all constituents of concern must be determined prior to the implementation of this Action Plan.

**All laboratory MDLs, when completed by the laboratory, will be incorporated into the QA/QC Plan by an addendum. The MDLs are expected to be complete by July 10, 1997.**

Section 9.2, pg 42 - There are no levels of data validation indicated for SW-846 Methods 8151 and 8330.

**The requested validation levels have been added.**



Massachusetts Department of Environmental Protection - June 16, 1997  
**(responses in bold)**

General Comments

As previously commented, the Department recommend and due diligence requires that a phased investigation, Initially focusing on source areas, be initiated to determine the magnitude and extent of contamination associated with military (disposal) and training (explosives) activities on groundwater and soils (surface and subsurface) within the Training Range and Impact area.

The following comments are provided for your review and consideration:

1. As a first step, a detailed historical use site plan of the Training Range and Impact Area must be developed to clearly delineate areas used for various training activities as well as target and disposal areas. For example the mortar fire impact area in the vicinity of Succonsette Pond -- an area of overt environmental stress--has not been previously identified as an area of concern. This area, as well as other potential source areas not previously identified, should be targeted for focused groundwater and soil investigation during the first phase of this investigation.

**Section 3.1.1 describes the historical use report that is being prepared for this study.**

Until all potential source area characterizations are completed, a comprehensive evaluation of the environmental and human health risks posed by past and current activities conducted in the Training Range and Impact Areas is not possible.

2. A Superfund Chemical Data Matrix consistent with the format presented in EPA 540-R-94-00, June 1994, should be developed the National Guard Bureau (NGB) and be incorporated in the first project technical deliverable. The matrix should provide human health and environmental factor and benchmark values for all explosive compounds and degradation products to be evaluated in this study.

**Information consistent with this matrix will be presented in the Preliminary Risk Evaluations described in Section 3.2.**

3. The Department does not agree that the number of wells that the NGB has proposed to install within the impact Zone is sufficient to characterize the aquifer beneath this area. At a minimum, the NGB should install well nests at each of the potential sources areas previously identified in Environmental Protection Agency (EPA) comment resolution correspondence of 8 May 1997, plus any additional potential source areas identified as a result of on-site surveys or development of the aforementioned historical use site plan.  
**As discussed at the June 18 and June 26, 1997 meetings with EPA and other stakeholders, additional groundwater monitoring wells are being installed at and around potential source areas.**



Well locations within the Impact Zone should be selected based, in part, on the results of a thorough evaluation of soil samples from all identified potential areas, and in part, on historical data that indicate an area may have been a past potential source area.

**NGB agrees that it would be more cost effective to select well locations after soil data are available, and this is a typical investigation strategy. However, NGB and EPA believe that a “front-loaded” strategy in which wells are installed as early as possible (in the absence of soil data) is necessary in this instance, to address the public concern with potential future drinking water supplies.**

4. Previously the Department had commented that "Surface water and sediment sampling and analyses should be conducted on all surface water bodies in the Impact Area. The Plan must include sampling of Bailey's and Gibbs Ponds as well the Bypass Bog". The military's response (volume III, Appendix G) was that "All surface water bodies within and around the range training and impact areas are slated to be sampled. However, the Plan still does not include Bailey's and Gibbs Ponds, the Bypass Bog, or the Raccoon Swamp A,B, D and E. The Department recommends that these surface water bodies be sampled.

**The Action Plan has been revised to indicate that the two ponds, bog, and swamp will be sampled. Also, IRP testing of Snake Pond will be evaluated for inclusion in this study, and this pond tested if existing data are inadequate.**

In addition, proposed surface water sampling: Page 13, Section 2.2.1 Physiography and Surface Waters, states that "Only one of these kettle holes, (in the training range/impact area) Succonsette Pond ... contains water". However on page 48, Section 3.1.4.1 Surface Water and Sediments Sampling , the NGB states that "Surface water and sediment samples will be collected from four ponds in the training range and impact area". Further, this section states that most kettle holes in the Study area are dry....However, the swamp area and five of these kettle holes appear to be deep enough to possibly intersect groundwater, and these will be sampled. Please clarify.

**The words “training range” have been deleted from the fifth sentence in this section to clarify that Succonsette Pond is the only kettle hole in the Impact Area that contains water.**

5 . The figures presented in the Plan still do not consistently show the area of the Impact Area, some figures do not include the Training Area, and some do not include the Demo Area at the northern boundary. Please modify the figures for consistency.

**The figures are used to illustrate different aspects of the study area and are the best available at the current time. The figures are derived from multiple sources and many are not available in electronic form. Therefore, the features and scale are not easily manipulated for the purpose of this plan. As the Action Plan is implemented and results are presented, a consistent set of maps will be prepared that show relevant features based on discussions with EPA, MADEP, and other stakeholders.**

6. The Department recommends that the NGB coordinate its efforts with the Camp Edwards Environmental Protection Office to minimize ecological impacts during the investigation.



**This coordination has occurred and will continue.**

7. Groundwater samples at all well locations within the impact zone should be analyzed for explosives and a full suite of organic and inorganic compounds. Soil samples from source areas with potential contamination from non-training activities should be analyzed for the same parameters consistent with the available historic information for these areas. The proposed sampling should assure that a reasonable assessment has been conducted to satisfy due diligence requirement. Composite soil samples should be avoided in areas potentially impacted by non-training (suspected chemical disposal) activities because of the inherent dilution (lack of sensitivity) effect of this sampling technique.

**Groundwater samples and many soil samples will be analyzed for the full suite of organic and inorganic compounds, in accordance with EPA comments dated July 3, 1997.**

Page Specific Comments

8. Page 4, Section 3.1 Investigation

For clarity, table 4-1 should be referenced in this section.

**Table 4-1 has been removed from the Action Plan in accordance with revisions to present a separate sampling plan for each area of concern (see response to EPA comment 18).**

9. Page 9, Section 1.4 Environmental Concerns at the Training Range and Impact Area

The NGB states in this final paragraph of this section that “30 percent of all samples collected” will be analyzed for non-munitions related constituents. This percentage, as applied to soil sampling, does not agree with the sampling program described on page 50. **NGB assumes that the commenter means page 60 rather than 50, since page 50 does not describe the soil sampling program. This sampling program is being revised in accordance with the program summarized by EPA in their July 3, 1997 letter. The 30 percent is no longer applicable and has been deleted from the text.**

10. Page 10, Section 2.1. Location and History, 2<sup>nd</sup> Paragraph

Please clarify what is meant by “The environmental interests associated with these activities could potentially effect groundwater.”

**The word “interests” has been replaced with the word “impacts”.**

11. Page 41. Section 3.0 Task Evaluation and Scope

As stated, “NGB will develop a Response Matrix... for responding to issues resulting from the findings of the field investigations.” The Department recommends that the Response Matrix be developed and approved before field activities begin. Please include this Response Matrix in the Final Plan.



**A Draft Response Matrix was provided to EPA on May 30, 1997, and is currently under review. This document will be revised and updated as needed during the Impact Area study.**

Additionally, the initial scope of work should also include a Preliminary Risk Evaluation (PRE) in accordance with the Risk Assessment Handbook (RAH).

**Completion of PREs is discussed in Section 3.2.**

**12. Page 49, Section 3.1.4(ii), Soil sampling**

Please justify the use of FID screening (presented in this section and throughout the Plan) for prioritization of soil samples from the Impact Zone for subsequent Laboratory analysis. Many of the Contaminants of Concern (CoCs) are not volatile and/or inorganic.

**The primary COCs are explosives and metals, and the FID is not being used to screen for these nonvolatile compounds. Other COCs include Volatile Organic Compounds (VOC), Semivolatile Organic Compounds (SVOC, some of which are detectable using a FID), pesticides, herbicides, and Polychlorinated Biphenyls (PCBs). Although the FID is generally not expected to detect the latter three categories of COCs, these compounds are sometimes colocated with VOC or SVOC due to the characteristics of the material(s) released or the disposal activity.**

**13. Page 50, Section 3.1.4.3, Groundwater Sampling**

Consideration should be given to determining the screening interval of existing IRP (CS-1, PS-12, etc.) wells before proposed sampling. Many of the proposed wells are screened at the water table as source area monitoring points and their utility for this study is questionable.

**Screen intervals will be considered in selecting wells for sampling.**

In addition, the four (4) groundwater monitoring wells in the Fuel Spill (FS) No. 14 Study Area, in the vicinity of Demo Area No. 2, should also be included in the proposed existing well sampling. These wells are critically located in an area with little or no available hydrogeological and groundwater quality information. Water level and quality data from gauging and sampling these and other existing groundwater monitoring wells in the vicinity of the Impact Area should be used to refine the siting proposed "outer ring" monitoring well clusters.

**Existing data for FS-14 will be evaluated for this study, and additional data collected if necessary.**

**14. Page 50, Section 3.1.4.4. Storm Water Sampling**

The Department recommends that "first flush" grab samples from significant runoff areas be collected and analyzed for a full suite of parameters (Including VOCs and SVOCs) for major storm events (> 1 inch of precipitation in 24 hours) for the duration of the



investigation. Although labor intensive, the manpower required to collect these more meaningful samples can be minimized by the use of predictive meteorology.

In addition, please justify why only seven of the nine subwatersheds will be sampled for the storm water. The Department believes that storm water samples should be also be collected from the remaining two subwatersheds as an experimental control representative of stormwater flow into the Impact Area. The northern most subwatershed (not proposed for sampling), as shown on Figure 3-3, is adjacent to and potentially impacted by Demo Area 2 and the Fuel Spill (FS) No. 14 Area of Study.

**"First flush" grab samples will be collected from the nine subwatersheds as described above.**

#### 15. Page 53, Section 3.1.5 Investigation Well Installation

An apparent typographical error in the second paragraph causes uncertainty concerning where the screened interval at deep well at each nested well location will be screened: "At two of these locations, a nest of two wells will be installed including one at the water table and one screened in above the bedrock or the silty clay layer (if present). Please clarify whether "in above" should have been "in" or "above" bedrock, as well as the criteria for selecting the two locations.

**The language has been revised to clarify that screens will be above the silty clay layer, or if this layer is not present then above bedrock.**

In addition, the Department recommends that the use of "stick up" wells be avoided in the Impact Zone to avoid damage from non-explosive projectiles. These groundwater monitoring well locations should be "hardened" by completing them below ground surface with a projectile-resistant protective cover.

**Monitoring wells in the Impact Area will be finished flush with grade using a metal road box set in concrete.**

#### 16. Page 55, Section 3.1.6 Elevation and Location Survey of Investigation Wells

In the May 4, 1997, meeting between the NGB, Cape Cod Commission, EPA, and DEP, the NGB stated their intent to survey and observe water levels as wells are installed in a sequence that will allow for the readjustment, as needed, of subsequent well locations. Please add text to this section to reflect that agreement.

**The text has been revised to indicate that several synoptic rounds of water level measurements will be completed during the study, and the results used to evaluate positions of remaining proposed wells.**

#### 17. Page 56, Section 3.1.9 Aquifer Testing

Please provide further detail concerning proposed aquifer testing.

**The referenced text is being revised to indicate that pump tests are not being proposed at this time.**



18. Page 56, Section 3.2 Preliminary Risk Evaluation (PRE)

Please clarify how the MMR Risk Assessment Handbook (RAH) will be “updated to meet the focus of this study”.

**The RAH is currently being updated by AFCEE, although this process is not expected to be complete by the time risk assessments are underway for this study. Risk assessment procedures that are consistent with the AFCEE revisions will be proposed in the risk assessment workplan that is described in Section 3.2.**

In addition, please detail the process by which the human health screening concentrations for surface water, sediment, groundwater, and soil (concentrations for no adverse noncarcinogenic affect and  $10^{-6}$  cancer risk) will be developed for the explosives. Also, please detail the ecological screening concentrations for all the media for the explosives. The Department should review any proposed screening concentrations before they are used for the project, in particular since the PRE only evaluates ecological risk if the concentrations exceed the Tier I human health criteria.

Also, the PRE must be completed for surface water and sediment according to the RAH. Please include a discussion of this process.

**Detailed descriptions of risk assessment procedures will be included in the risk assessment workplan described in Section 3.2.**

19. Page 57 Section 3.3.2 Response Plans

Please clarify if the Response Plans are the same as the response matrix.

**The text has been revised to indicate that Response Plans will describe additional investigations needed to resolve issues identified during implementation of the Action Plan. The Response Matrix describes situations that require preparation of Response Plans, and other appropriate responses (e.g., communications).**

20. Page 58, Section 3.3.4, Long Term Monitoring

It is the Department’s understanding that the ANG is committed to developing a Long Term Monitoring Program to assure the long term integrity of public water supply wells located in the vicinity of the Training Range and Impact Area.

**NGB is committed to this goal.**

In addition, the department continues to recommend that the newly approved EPA Method 8320 be used for groundwater analyses for Zone II sentinel wells and for preselected (background and upgradient Areas) groundwater monitoring wells within the Impact Area.

**NGB does not believe that Method 8320 has been approved by EPA. In any case, performance data for this newly drafted method are not currently available. NGB recommends that Method 8330 be used until other approved methods with demonstrated performance data are available.**



## 21. Page 60, Table 4-1, Sample Types, Numbers and Analytes

The Department recommends that at least 10% of the Explosives by Colorimetric Methods (Expl) be verified by duplicate laboratory analysis using EPA Method 8330.

**Overall, 10% of all samples that show detectable levels of explosives by colorimetric methods and 5% of all samples that show no detectable levels of explosives by colorimetric methods will be analyzed by EPA Method 8330, in accordance with EPA's July 3, 1997 comments.**

## 22. Page 63, Section 4.1.4 Soil Sampling

The Department does not agree with the approach presented in this section for evaluating potential soil contamination at gun points. Specifically, one composite sample at each location (except Target zones) is inadequate to confirm or deny the presence of contamination. In addition, the ability to define the "worst case" location by visual observation is also questionable. Using a location "near the center gun or mortar position" as a contingency "in the absence of visible contamination" presents difficulty based on historical operational practices as confirmed in the GP-9 study (CS-18) --propellant bags were typically burned on the roadway at the entrance to the gun Points.

The dependence on surface soil sampling results to determine if additional investigation efforts may be required is questionable. Given the known operative surficial degradation mechanisms for explosive compounds, subsurface soils affected by infiltrated surficially deposited explosive compounds potentially pose a greater threat to groundwater in the Training Area and Impact Zone. Please reevaluate this investigative approach.

**The soil sampling approach that was developed in discussions with EPA and other stakeholders during the June 18 and June 26 meetings, and summarized in EPA's July 3 letter, will be used for the gun positions.**

## 23. Page 74, Figure 4-2, Zone II Wellhead Protection Areas

This figure is incomplete, as well as mislabeled (should be Figure 4-2, not figure 4-1). Please revise this figure to include all Zone II for all Long Range Water Supply (LRWS) test well locations, as well as the locations themselves and their corresponding Site number. **A map depicting the Zone II areas of all of the current and planned production wells in the vicinity of the impact area is not currently available. As a surrogate to this, Figure 3-1 provides the estimated zones of contribution to a set of planned production wells located adjacent to the Impact Area. These planned production wells were prioritized by the Cape Cod Commission, and the USGS provided estimates of the zones of contribution under two different pumping conditions. This figure was used to place monitoring wells to maximize the probability of the interception of any potential plumes emanating from the Impact Area. NGB will continue to work with the LWRSPAT to refine the regional groundwater model as well as define the areas of contribution to water supply wells.**



Page 85, Figure 7-2 Schedule as of 5/16/97

Page 85 is followed by page 87. Please clarify whether a second page to this figure is missing. Also, Activity ID line number 550 specifies "Monthly Progress Reports". The Department also requests that weekly operational meetings be scheduled to provide data as it is received from the field to both the EPA and to the DEP. This is required to support NGB's efforts to inform EPA and DEP of field information that may change planned drilling, aquifer testing, and/or sampling locations.

**There is no second page; the page numbering will be corrected. NGB is providing written weekly progress updates to EPA, and these can also be provided to DEP with EPA approval. Meetings will be scheduled with EPA as needed to discuss significant results, and DEP will be notified when these are scheduled to occur.**

Page 90, Section 9, References

Please provide copies of reference numbers 15, 16, 21, 22, 23, and 24 to the Department. **NGB will provide the requested references to MADEP.**

Volume II, Appendix A, Section 7, Page 30, Table 7-1(a), Analytical Procedures

The detection limit for RDX (Royal Demolition Explosive) and cross-sensitivity for other explosive compounds and their degradation products for the proposed CRREL Method must be provided to the Department before this method can be utilized for field screening in this program.

In addition, please verify the detection limits for explosives in soil using EPA method 8330 presented in this Table 7-1(a). As previously stated, these detection limits are overly optimistic. If these detection limits can not be realized using EPA Method 8330, then the use of field compositing for explosives analyses or the analytical method utilized may have to be reevaluated.

**Method Detection Limit (MDL) studies are currently being completed and are being provided to EPA for review. An addendum to the QA/QC Plan will be submitted to EPA when the MDL studies are complete and all Standard Operating Procedures are available.**



Cape Cod Commission, Tom Cambarerri, dated June 16, 1997  
**(responses in bold)**

This is the fifth opportunity I have had to comment on the Impact Area Scope of Work. The Impact Area scope of work has yet to commit to a characterization of water quality within the contributing areas to the potential water supply well sites.

There are several reasons among many that the ANG should commit to these monitoring wells: 1) The Upper Cape Community needs additional water now and will need more in the future, 2) The Upper Cape Community is counting on the potential water producing capacity of the Sagamore Lens surrounding the Impact Area, 3) Groundwater that has emanated from the Impact Area towards these resources needs to be characterized, 4) This issue is too important to delay to the deliberate and time consuming response and work plans, contracting and approval process that has burdened the Installation Restoration Program, 5) This is critical information for long range water supply planning aspects of the MMR Master Plan which is to be completed this year.

**See the response to Comment 1 below.**

The following are my technical comments:

The Impact Area scope of work has yet to commit to a characterization of water quality within the contributing areas to the potential water supply well sites. We have very good regional groundwater flow information and models to adequately locate these monitoring wells. This step should be included as a specific item within the scope of work, focusing first, on potential well locations 95-6, 95-15, and sites 1, 2, 3, and 8. Use of the term sentinel wells should be dropped; they are not guarding or protecting anything. They are far-field groundwater monitoring wells to provide critical information on groundwater quality, flow direction and geology in primary public health exposure pathways.

**As agreed at the June 18 and June 26, 1997 meetings with EPA and other stakeholders, monitoring wells are being repositioned to fall within the modeled zones of contribution that have been identified by USGS. These zones are illustrated on the map of proposed well locations (Figure 3-1) and will be considered for positioning any additional wells that are required based on the results of this groundwater quality study.**

**NGB continues to believe that placement of a fence of “sentinel wells” around the planned groundwater production sites is likely to be very inefficient. As noted in comments on the Action Plan by the USGS, placement of the wells without the benefit of the most complete data possible is likely to be problematic. Plumes observed elsewhere on Cape Cod have been observed to migrate both laterally and vertically such that placement of well screen in the plume is not always a simple matter. NGB strongly believes that placement of these wells now will unnecessarily increase the chance of missing any plume(s) that might be present. We believe that placement of**



**sentinel wells is better considered when the additional data on the water table configuration, stratigraphy, and contaminant distribution and fate are available. Of course, NGB is hopeful that the need for such sentinel wells will not be demonstrated. If no significant contamination of groundwater is observed in the Impact Area and its environs, it is quite arguable that no sentinel wells will be required from NGB.**

- 2) Pg 39 includes a discussion on flow through the unsaturated zone. There was an excellent Tritium study at FS-12 looking at groundwater ages that may be helpful.  
**NGB will review the referenced study for relevance in modifying the Site Conceptual Model. This model is incorporated in the Response Matrix for the site, which will be revised as needed to allow effective evaluation of study data.**
- 3) Pg 36 includes a discussion indicating that uncontaminated groundwater is oxidizing so heavy metals will be immobile. There are naturally occurring areas of the aquifer that are reducing zones where heavy metals will be mobil.  
**This discussion of the Site Conceptual Model has been revised to indicate that there are reducing zones in the aquifer where heavy metals, if present, may be mobile.**
- 4) Pg 9 indicates that the Administrative Order is focused on groundwater quality beneath the impact and training range areas. The intent of the Administrative Order is to characterize groundwater quality on, beneath and emanating from those areas.  
**The words “and emanating from” have been added to the text.**
- 5) Pg 50 The scope still does not recognize the Bourne Wells 95-6 and 95-15.  
**These wells will be added to the study by including existing data, or collecting new data if existing data are inadequate.**
- 6) Pg 52 The discussion indicates that surface runoff is non-existent, so why is the scope of work proceeding as if there were valid drainage basins? This is the epitome of following a procedure to the extreme. The drainage sampling locations should be moved to activity areas within the Impact area where ponding of runoff due to silty sediments is evident.  
**The requirement for storm water sampling is contained in EPA’s Administrative Order. Also, DEP indicates an interest in retaining these samples in their comments.**
- 7) Pg 54 Indicates 12 follow-up wells will be shallow water table wells that will be located contingent upon the initial findings of the preceding 37 wells. These wells should proceed as deep investigation locations with screened auger sampling on the way down.  
**The single wells discussed here are located at a depth between the top and bottom of the aquifer, as described in the text.**
- 8) Pg 54 If the screened interval is located within a permeable sand, a sand pack is not necessary. Has there ever been a study to evaluate the difference in water quality from a screened auger sample to that of a sand packed permanent well?  
**NGB is not aware of such a study.**



9) Pg 55 Grout is mentioned here but, there is no explanation of its use here or in the preceding protocol.

**Grout may be used downhole for sealing as described in the monitoring well SOPs referenced in Section 4.0.**

10) Pg 56 Mentions pump tests, they are not necessary to estimate and determine relative permeability at this time.

**The referenced text has been revised to indicate that pump tests are not being proposed at this time.**

11) Pg 57 Indicates that the ANG will partner with other federal agencies. Which ones? ATSDR? EPA?

**NGB is partnering with Los Alamos National Laboratory (LANL) and the Army Center for Health Promotion & Preventive Medicine (CHPPM) in order to perform the risk assessments. NGB has proposed to EPA that LANL will perform the ecological risk assessment, Ogden will perform the human health risk assessment, and CHPPM will review the work of both parties.**

12) Pg 57 Discusses Response Plans to be prepared as conditions warrant. A Decision Matrix has been verbally discussed by the ANG. This Decision Matrix should be included here.

**A Draft Response Matrix was provided to EPA on May 30, 1997, and is currently being reviewed. The Response Matrix will be revised and updated as needed during the Impact Area study.**

13) Pg 58 Indicates that a long term monitoring plan "may" be developed. This monitoring plan should include the upgradient monitoring wells to be placed within the primary capture areas of the potential wells.

**See response to comment 1.**

14) In section 4.2.4 of the Sampling and Analysis Plan, the map for the conceptual capture areas is not included. I recommend that the USGS capture areas map be used here. In addition, the Zone II map for existing wells is out-of-date. The most northern well in Sandwich has been taken off line. The discussion here indicates that the maps will be reviewed to determine if the Impact Area falls within the capture area to the surrounding existing and future wells. That examination has occurred and the impact Area does in fact fall within the capture area of the wells. Please update this section and see that it references the scope of work detailing how groundwater monitoring wells will be located in these areas, to characterize groundwater quality.

**See response to comment 1 regarding capture areas. Figure 3-1 has been revised to show the USGS capture areas. Monitoring well locations have been modified to coincide with these areas, in accordance with discussions with EPA and stakeholders.**



15) The Project Management chart needs to be updated to include the Impact Area Study Review Team and its members. The old chart was missing the USGS as a member of the LRWS-PAT. Throughout the document, changes for review from the LRWS-PAT to the new review group should be made.

**The requested changes have been made.**



USGS comments, John Masterson and Don Walter, dated April 16, 1997  
**(responses in bold)**

Well Location and Depth

1. The locations of the proposed monitoring wells as discussed on page 27, are "based on the current understanding flow and anticipation of down-gradient locations from the suspected source areas". Given that there is very little available information on this part of the ground-water flow system because of the presence of the impact area, this phase of the investigation should be focused on developing, or improving, the current understanding of flow system before embarking on a "plume hunting" exercise. Improving the understanding of this part of the flow system will certainly be of great long-term benefit to future water-resources investigations in the Upper Cape as well as the ongoing investigations conducted by the IRP at the MMR.

**NGB agrees that additional information is necessary to refine our current understanding of the flow system. The investigation is designed to help provide information on the general quality of the groundwater in the impact area while providing critical data (e.g., depth to bedrock, stratigraphic data, water table configuration) to help refine the groundwater model. At the request of the USGS, monitoring wells have been relocated to maximize their utility in refining our knowledge of the regional hydrogeology. NGB has asked the USGS to help with this portion of the investigation.**

2. Since there is very little information available on the subsurface geology in this part of the flow system, we strongly recommend that each proposed well cluster include one well cored to bedrock. This investigation should be used to verify/update the geologic model detailed in the USGS hydrogeologic framework report (Masterson and others, 1996) rather drilling to "just above the Sagamore Silty Clay layer that constitutes the bottom of the aquifer (USGS, 1996)" as discussed on page 36.

**After considerable discussion with EPA, DEP, CCC and the USGS, the NGB has agreed to drill the deep well at each well cluster to bedrock. Currently NGB is proposing to drill 14 wells to bedrock.**

3. It has been discussed at past Long Range Water Supply Process Action Team Meetings (LRWS PAT) that monitoring well locations also be selected to serve as "sentinel wells" upgradient of the potential water-supply sites. The concept of "sentinel wells" can be problematic depending on the nature of the contamination. If the contamination is from a nonpoint source, then sentinel wells may detect the general zone of contamination; however, if the contamination is in the form of smaller, more localized plumes, then the chance of any individual monitoring well site detecting contamination becomes small. Based on flowlines to a typical public-supply well in western Cape Cod, it becomes obvious that carefully placed well fences will be needed to provide an adequate early warning mechanism to any potential supply site.

**NGB is aware of the difficulties involved with providing "early warning" type monitoring wells. Once we have a better understanding of the groundwater flow and more information on the groundwater quality, a long-term monitoring program will**



be developed. In particular, information on the water table configuration and the overburden stratigraphy will be used to predict groundwater flow patterns. The observation of contaminants in groundwater will be used to prioritize and optimize sentinel well placement. Such wells will be placed in an effort to maximize the chance of encountering any site-related contamination. This process will consider site hydrogeology as well as contaminant fate and transport and may involve groundwater model application. All of these factors suggest that placement of sentinel wells without the new data on the Impact Area is likely to be inefficient and result in unnecessary costs without clear benefit. Placement of sentinel wells at this point increases the probability that a "false-negative" result might occur.

4. The placement of these well fences requires a source-of-water to wells determination for each of these wells. The preliminary Zone II delineation on page 53 does not provide this information. Each of these Zone IIs were determined independently of one another, which therefore does not account for the combined effects of pumping all of these wells simultaneously. The USGS, at the request of the EPA, has used its regional model to determine the source-of-water for all of the proposed well sites under pumping conditions of 600 gallons per minute (gpm) and 1200 gpm. This information has been sent to the EPA and will be included in their comments on the action plan.

**NGB will work closely with the USGS to ensure that the long-term monitoring program takes into account the simultaneous pumping of all current and proposed production wells affecting the ground-water flow. In fact, NGB has reviewed the USGS source-of-water estimates and relocated planned monitoring wells to fall within these areas. If sentinel wells are necessary, this information will be considered in their placement.**

#### Ground-Water Modeling:

5. The discussion on page 26 includes the need to "verify the flow model" yet there is no mention of developing a ground-water model in the action plan. Will a new flow model be developed for the Impact Area or will an existing model be used for the analysis? Currently, there is the USGS regional model that has recent been updated by the IRP consultants based on additional data. Either of these models could be used to provide rough approximations of flowpaths and travel times from potential source areas to supplement proposed monitoring well locations as well as provide an estimate of the regional effects of the large-scale pumping (approximately 17 MGD at maximum capacity) from the LRWS PAT water-supply sites on flowpaths and potential contaminant migration.

**It is NGB's intention to adopt and refine the USGS regional groundwater flow model in much the same fashion as the IRP contractors have done. NGB will work closely with the USGS and IRP to continue to update the USGS regional model and this model will be used for all modeling conducted in conjunction with this study. The goals of the modeling will be those outlined in the USGS's comment: establishment of groundwater flow patterns to define areas of contribution to wells and potential paths of contaminant migration.**



Long-Term Monitoring:

6. The discussion on page 41 regarding long-term monitoring states that "after the initial data has been gathered and the ground-water model has been verified, ANGB may develop a long-term monitoring program". The USGS has shown with flow model simulations that slight changes in hydraulic gradients can have significant effects on flowpaths in the vicinity of the MMR. The effects of gradient shifts on flowpaths in the impact area should be of particular concern because ground-water levels fluctuate annually by as much as six feet near the top of the ground-water mound. Understanding these season water-table fluctuations will be critical in characterizing and remediating ground-water contamination beneath the impact area. Therefore, we strongly recommend that the ANGB not only commit to a monitoring program, but also include sites for long-term monitoring in the design of the initial phase of the investigation. Long-term monitoring data have been collected on Cape Cod for the past three decades by the Cape Cod Commission in cooperation with the USGS. The IRP, in cooperation with the USGS, is already designing a comprehensive monitoring program to assess the long-term effects of the proposed plume contaminant systems at the MMR. The monitoring proposed in this action plan should be integrated with the IRP efforts.

**NGB is conducting synoptic water level measurements during the investigation to help account for the seasonal water-table fluctuations. NGB will work with USGS and the CCC on the development of the long-term monitoring program. Such a program will very likely include periodic performance of synoptic water level measurements to evaluate changes in groundwater flow direction.**



James Kinney, Alliance for Base Cleanup - Comments dated June 8, 1997  
**(responses in bold)**

1. Pg. 5: Training operations conducted at the MMR Impact Area are outlined: small arms firing; artillery firing; and demolition ranges. However, the groundwater quality study should include ALL current and historic uses of the Impact Area including illegal and legal dumping of hazardous wastes and the use of pesticides and herbicides.

**Although ordnance and training related compounds are the primary focus of the impact area study, the study will include other activities as described in Section 1.4, and tests will be performed for non-munitions compounds.**

2. Pg 6: "A thorough review of the archives to investigate the type and volume of munitions used ... investigation of suspected potential sources of contamination..." is not sufficient to meet the study's objectives. Interviews with past users and observers of Impact Area need to be conducted to ensure that all information sources and all "unrecorded" potential contamination sources are evaluated.

**Comment noted. Support of local residence and past users of MMR is and has been crucial to identification of potential sites not found in training records, on aerial photographs or visually detectable today. Interviews are an integral part of the archive search.**

3. Pg 7: The bias implicit in the statement that :When the [artillery and mortar] rounds fired are detonated, the explosive materials are *generally* consumed ..." must be corrected. We have no evidence that explosive materials are *generally* consumed. How much is, in fact, consumed? How much, specifically, is left?

**Comment *generally* was used so as not to bias the reader. Munitions, age, condition, handling and impact environment can contribute to partial or incomplete detonation. The exact information regarding exact consumption under all variables may be impossible to determine. What the study will seek to determine is how much residual materials are present in soils and it's ability to move into the groundwater.**

4. Pg 7: Add to list of "Environmental Concerns" legal, illegal and undocumented dumping areas.

**The requested change has been made.**

5. Pg 8: "The primary environmental interests associated with the historic, current and future use of the training range and Impact Area involve the metal projectiles from fired or "spent" munitions." That statement is not true: interests also include unconsumed explosives, propellants, herbicides, and dumped materials (i.e.; from crankcases and fuel tanks of tank and vehicle targets).

**A paragraph listing other activities of potential concern has been added.**

6. Pg 8: Three unsupported and vague statements illustrate a study bias that could jeopardize results: "The propellant is *almost completely destroyed* during firing...." and "*Most* of the explosion in a HE projectile *are destroyed* at impact." Please quantify these



unsupported statements. Additionally, it is stated that "There are *no* explosives used in the artillery projectiles." This may be true recently, but it has not been true historically. There may also be a disagreement about semantics. I understand that a smoke marker chemical and small charge of some sort are currently used in these rounds.

**The text has been revised to indicate that the PEP components are designed to be completely consumed. *Almost completely destroyed* and *most* of the explosion in a HE projectile *are destroyed at impact* accurately reflect the design purpose of explosives. Explosives improvements have sought quick and complete consumption of compounds to produce a greater explosive effect per given weight of ammunition. Firing units monitor ordnance which does not produce a full explosive functioning effect. These ordnance are tested to determine if manufacturing or transportation/storage abnormalities have reduced their effectiveness. If so, entire lots of ammunition are withdrawn from service and destroyed or returned for manufacturing correction. The signal marking component of the LITR more accurately meet the description of a pyrotechnic than an explosive. Compounds in signal charges are a part of the study.**

7. Pg 9: An archives search probably will not be able to discover all past activities at the Impact Area. Interviews with past users and observers must be undertaken and their statements investigated.

**Public information and support of the study is essential and has already produced valuable information regarding past activities. Interviews are an integral part of the archive search.**

8. Pg 10: The primary focus of this investigation is NOT just the Impact Area but also the small arms ranges, demolition ranges, artillery and mortar positions and the Rod & Gun Club.

**The requested change regarding the study area has been made.**

9. Pg 13: The study area delineated here does not include shooting ranges S-W and S-E nor Gun Positions 2-24. These should be included in all aspects of the study.

**The text has been revised to better reflect the limits of the study area.**

10. Pg 22: If it is true as stated that groundwater samples from GP-8 and GP-9 taken by USACHPPM in a propellant burning follow-on study in 1994 were analyzed just for VOCs, then new samples should be collected and analyzed for a broader suite of potential contaminants, including lead, herbicides and explosives.

**If insufficient data are available to characterize the target analytes for the area of concern, then a new groundwater sample will be collected and analyzed.**

11. Pg 37: Propellant materials can be introduced to the soil in the vicinity of gun positions by air deposition through the firing of guns, not just simple ground disposal, bag burning and "wash-out." Please add air dispersion as a potential avenue of propellant contamination. The air deposition pathway is described in the text. The three pathways described in this comment are for "materials disposal", as stated in the text.



12. Pg 37: If it is true, as stated, that "The persistence and mobility of explosive materials... is likely to vary substantially with site conditions." Then all gun, mortar and artillery positions should be sampled to ensure that all potential contamination is discovered.

**Variability with site conditions is taken in a much broader context than from gun position to gun position at MMR. The statement takes variance to mean by regional and geographic conditions. The site conditions at MMR are reasonably constant throughout the study area.**

13. Pg 38: Add to potential migration pathways of munitions-derived materials, the pathways of air dispersion and uptake of contaminants into vegetation and the animals who may eat that vegetation.

**Comment noted. The text has been revised to clarify that the discussion is of migration pathways to groundwater.**

14. Pg 38: "The munitions-related materials in and around the Impact Area are most likely to be found in surface soils." This is an unfounded statement, contradicted by the findings of TNT, RDX and HMX in groundwater below the surface soils of the Impact Area. This assumption cannot be allowed to limit the scope of the study and the sampling protocol.

**Verified findings of TNT, RDX and HMX in groundwater would support the need for groundwater sampling for those compounds but in no way would lessen the likelihood that the potential pathway to groundwater would be through surface soils. Soil testing in the impact area will provide valuable insight into fate and transport of compounds to groundwater.**

15. Pg 39: "... it is difficult to predict the exact path of any potential groundwater plume." If this statement is true, it is a clear reason to add more groundwater sampling wells throughout the study area.

**The Action Plan specifies additional wells to aid in the determination of groundwater flow models which will allow more accurate prediction of potential plume paths. The response matrix will determine the need for additional wells based on laboratory analysis of initial wells.**

16. Pg 42: More wells and soil samples should be taken southwest and northwest of the Impact Area near gun positions.

**Additional wells and movement of some wells have been made to the plan, in accordance with locations agreed upon during the June 18 and June 26 meetings with EPA at the MADEP-SERO. This should allow for better coverage of some areas and assist in characterization of zones of contribution for potential water supply wells.**

17. Pg 49: While CS-19 is being investigated by the IRP, Mr. Snvder has indicated that IRP cannot expand its study up gradient of CS -I 9, even though groundwater contamination has been discovered there. To avoid data gaps, the Army National Guard should also conduct a study of CS-19 and vicinity.

**The revised plan includes monitoring wells upgradient of the CS-19 area of concern.**



18. Pg 53: Twenty-five locations for data-gathering wells are not sufficient coverage in an area as large as the Impact Area when the Upper Cape's future water supplies are at risk. More wells are needed.

**The 30 monitoring well locations in the current plan are part of a risk based focused approach which takes graduated steps at characterization of the impact area. The first areas to be studied are considered to be worst case sites based upon studies of aerial photography, archive searches and citizen input.**

19. Pg 55: Water level measurements in wells must be made seasonally to ensure accuracy. **Four synoptic water level measurements are planned during the study to account for seasonal differences.**

20. Pg 58: A long-term groundwater monitoring program MUST be developed to protect our water supply. Evidence collected thus far clearly indicates contamination of the groundwater under the Impact Area. This contamination must be identified and stopped as soon as possible.

**A long-term groundwater monitoring program will be developed.**

21. Pg 63: Soil samples should be taken at targets, "disturbed areas" and at random points throughout the Impact Area, not just at gun and mortar positions.

**Soil sampling will be performed at locations discussed with EPA and stakeholders during recent meetings. In addition to the gun and mortar positions and other potential source areas, these include "control" areas where there are no known environmental impacts.**

22. Pg 67: Groundwater samples should be collected and analyzed for a full range of potential contaminants (not just explosives) at ALL existing IRP and LRWSPAT wells, not just "some."

**Groundwater samples will be analyzed for a full range of potential contaminants at all wells, unless timely data of sufficient quality already exist.**

23. Pg 67. All groundwater samples should be tested for the full range of potential contaminants.

**All groundwater contaminants will be tested for the full range of contaminants, in accordance with EPA comments.**



Comments from Dick Prince dated March 26, 1997  
**(responses in bold)**

The Administrative Order issued by John P. DeVillars on February 27, 1997, includes in the Scope Of Work, Section II, paragraph B, the requirement that:

"By March 14, 1997, Respondent shall provide to EPA's Technical Project Coordinator and make available to the public an accelerated schedule and work plan with specific dates for conducting and completing an independent comprehensive study of the affect on public health and the environment of past, present and future activities on or near the Training Range and Impact Area."

In Colonel William R. Crocker's transmittal of March 14, 1997, to Ms. Jane Dolan, USEPA, it implies that this requirement is satisfied by the revised impact area groundwater study of the effects on public health and the environment of past, present, and future activities on or near the training range and impact area.

In the Draft Response to Comments submitted to National Guard Bureau by Engineering Technologies Associates, Inc., the response to comments by Dr. Andrea Papadopoulos, Massachusetts Department of Environmental Protection, on the December 1996 draft Action Plan states that "This investigation is not a CERCLA or IRP investigation. The scope and purpose of this study must not be confused with CERCLA or IRP driven studies that may be going on at the site. This study is voluntary, and intended solely to determine if there is ground water contamination beneath the impact area."

In addition, in response to MDEP's comment #2 which request a samples collected during this investigation be analyzed for the complete suite of organic and inorganic analytes, including ethylene dibromide (EDB), as well as for compounds associated with spent munitions and ordnance" the draft response states: "...the majority of those contaminants are not munitions related..... Therefore, the plan for the analytical scope in this phase is to analyze 100 percent of the samples for all explosives and munitions related metals, including iron, lead, arsenic and antimony. In addition, ten percent of the samples collected will be analyzed for the complete list of analytes."

Tom Cambareri, Water Resources Program Manager for the Cape Cod Commission also questioned the limited sample analyses for non munitions related contaminates but the draft responses do not address his question.

I realize that these are still draft responses; however, the table on page #43 of the Draft Action Plan submitted on March 14th again shows that both soil/sediment and aqueous samples will indeed be 100% analyzed for contaminants from all explosives and munitions but will still have just limited analysis for other contaminants.

The requirement of Mr. DeVillars as shown at the beginning of my letter makes no mention of only a groundwater study or just contamination from explosives and munitions but



requires a "comprehensive study of the effects on public health and the environment of Past, present and future activities on or near the Training range and Impact Area."

I do not believe that the Draft Action Plan as currently proposed satisfies Mr. DeVillars' requirement in this regard. I realize that this is Phase I of a continuing study but, in my opinion, considerable time could be saved if the original samples were fully analyzed.

**Groundwater samples will be analyzed for all potential contaminants, in accordance with EPA comments dated July 3, 1997.**



Paul Zanis' comments dated June 21, 1997  
**(responses in bold)**

General Comments on the final draft for the Camp Edwards impact area groundwater quality study.

1. Who is really in charge here?

**Section 1 of the Action Plan indicates that this study was initiated voluntarily in 1996 in response to EPA concerns regarding the effects of military operations on groundwater, and most recently is being performed in accordance with an Administrative Order issued by EPA. NGB is currently working under EPA directions as required by the Order.**

2. What happened to the last comments I sent in?

**Although NGB is cooperating fully with EPA in responding to comments, it is possible that prior comments were overlooked in the Draft Final Action Plan, especially if these comments were not sent directly to EPA and/or NGB. Mr. Zanis's earlier comments will be located if possible, and responses included in this Action Plan.**

3. Will you sample where the citizens want you to? Could you please stop wasting citizens time with irrelevant issues.

**NGB is working with EPA and other stakeholders to determine areas of potential concern for future investigation. These are being identified through an Archive Search that includes, among other things, interviews with citizens having knowledge of activities in the Training Ranges and Impact Area. Until these areas are identified, NGB is investigating areas which appear to have the highest potential for environmental impacts based on aerial photography and the existing history of operations.**

Specific Comments by page

4. Page-5 states fire training. What a mistatement that is, men almost died from out of control fires and the cost to town is great. There are no greater fires on Cape Cod than at MMR.

**NGB does not believe that the current statement attempts to minimize the size of the fires involved, some of which have been large. The statement only indicates that some training occurs at MMR in the process of fighting these fires.**

5. Page-6 1.3 Did you study the task-6 report, cs-1, cs-18, cs-19, fs-12, fs-14 including interviews? There is plenty of information already published on the impact area and surrounding land.

**NGB has incorporated information from the IRP studies cited above, where relevant to the Impact Area study.**

6. Page-7,8 Before you make statements like that you should study your own reports.



**It appears that the referenced statements contain a general discussion of the components of explosives. NGB believes the statements are accurate, although more detailed information will be provided when the Archive Search reports describing the chemical components of munitions are completed.**

7. Page-9 Change 30% to 100% and leave no questions.

**This sampling program is being revised in accordance with the program summarized by EPA in their July 3, 1997 letter. The 30 percent is no longer applicable and has been deleted from the text.**

8. Page-13 there are other places that contain water in the impact area.

**Succonsette Pond is the only known permanent surface water in the Impact Area. Other surface waters located outside the Impact Area, and stormwater runoff within the Impact Area, are being sampled as described elsewhere in the Action Plan.**

9. Page-14 sites are not in the right places.

**The sites shown in Figure 2-3 were identified based on aerial photos of the Impact Area taken between 1943 and 1991. (A more complete depiction of the areas of interest is provided in Figure 2-8 of the Action Plan). Additional areas are being identified through the Archive Search process described in Section 3.1 of the Action Plan. Investigations of these additional areas will be initiated and completed concurrent with the activities described in the Action Plan.**

10. How about old craters and new shell craters?

**Although individual craters generally cannot be identified from aerial photos, these craters and other visible characteristics (e.g., targets) would be used in the field to identify a focal area for sampling, as described in Section 4.0 of the Action Plan.**

11. N.B.C. Gas chambers, Moving target range, Old 50cal ranges, Avco J-1,J-2,J-3 pits, range control, USCG transmitter sight.

**See response to comment 9.**

12. Page-20 We need state of the art detection devices to find explosive compounds and whatever they change to.

**Analytical methods specified in the Action Plan will detect the target analytes.**

13. Page-22 Plant leave samples should be included like in other studies. Drainage swales also.

**Analysis of vegetation would be considered if contaminants, receptors, and exposure pathways are identified that suggest that an unacceptable ecological risk could occur. Drainage swale soil and stormwater will both be sampled as described in Sections 3 and 4 of the Action Plan.**

14. Page-24-28 must test for the right chemicals at all these sights.



**The known contaminants at these sites are included among the target analytes for this study.**

15. page-29 talks about the W.E.S. study. You should include summaries from all the other studies done on ranges with there findings. If the W.E.S. study continues it should be done at the old ranges which can give us a real life history no computers needed.

**The results of fate and transport studies at other ranges are being compiled and will be submitted at the conclusion of the Archive Search, as described in Section 3.1 of the Action Plan. The results of the Impact Area study will be provided as a stand-alone document. NGB is not aware of plans by W.E.S. to continue their studies.**

16. One sentence in a study I reviewed puts it all in a nut shell.” The ICP-AES results show that above-normal levels of lead and copper are in the surface soil at the handgun range, high concentrations of lead and copper are in the berm and soil surface at the rifle range, and elevated levels of cadmium and above-normal concentrations of arsenic, copper, and zinc are present in the surface soil at the hand-grenade range. The TCLP results show that surface soils can be considered hazardous waste because of lead concentration at the rifle range and because of cadmium concentration at the hand-grenade.” These metals have already been found in studies at Camp Edwards. (W.E.S., CS-19 studies). Vegetation absorbs these metals so they are in the food chain. We need to do a big clean up at Camp Edwards so lets all get started!

**NGB intends to determine whether these contaminants are present at unacceptable levels based on human health risk and ecological risk. These studies are needed and are required by EPA in the Order, before the need for clean up can be assessed. NGB is anxious to begin these studies as soon as an acceptable Action Plan can be agreed upon with EPA and the stakeholders.**

17. Page-33,2.4.2 Add this sentence to the paragraph, ”Heavy metal transport into groundwater supplies will produce adverse environmental affects on the local population.” A quote from [Heavy-metal Contamination on training ranges at the Grafenwohr training area, Germany]

**The discussion on this page is principally directed at fate and transport of munitions-related compounds, rather than toxicity. Relevant information regarding toxicity will be provided in Preliminary Risk Evaluations as described in Section 3.2 of the Action Plan.**

18. Page-33-38 Stop minimizing! other reports tell a different story. stop leaving out information, for instance, “composition B is highly corrosive” include this information in your study.

**The physical and chemical characteristics of Composition B will be provided in the Archive Search reports.**

19. Page-41-45 The steps taken for this study should be in the proper order and well thought out and honest. For instance at Succonsette pond Will the mud be taken from the bottom? The water squeezed out and tested?



**Sediment samples will be collected from the pond bottom, if possible in an area where drainage appears to enter the pond. The water contained in the sediment is included in the analysis.**

20. Page-46-56 The task-6, CS-19, FS-12, W.E.S., personal interviews reports. NGB has a wealth of information. Used properly a good study can be conducted.

**NGB intends to use the available information to ensure that the objectives of the groundwater quality study are met.**

21. Summary; Camp Edwards has salted the land with grenades and bullets and bombs. Chemical weapons have been used. I have seen chaff canisters blown into the sky by heavy artillery. I have witnessed the dusting of Cape Cod with constituents of bombs, now we must access the damage done after so many years of use.

Do not produce a inconclusive study  
Do not overlook high-probability test sites  
Do not test for the wrong toxins  
Do not use a questionable testing lab  
Do not ignore obvious conclusions  
Do not reject unfavorable test data

**NGB is committed to completing a scientifically defensible study that answers the question of whether military activities are affecting or will affect groundwater quality. This study will be performed in accordance with EPA's Order and with the input of other stakeholders.**



Paul Zanis comments of April 20,1997  
**(response in bold)**

This is my response to Paul Marchessault's right up of the site visit on March 8,1997. Paul was not present to here all my remarks at the different areas we visited that day, First off Sally Pry rocks and do not disturb sign were bulldozed on the other ' side of the street from where we first stood when the guard did there last expansion project.

Bailey's pond is of interest because it is a dumping area. I pulled a heavy artillery projectile with the lifting ring still In place and put it in the middle of the road so it would be found and properly disposed of, Other things have been found there also (powder bags and 50 cal ammo),.

The muddy road we took I call demo area 4 where all the boulders have been blown up down to Deep Bottom pond including the railroad tracks at the base of the hill and some boulders along the ridge line borders to the south across the tar road for the next two miles. Also the bridge at deep bottom pond. If it took 2 lbs of C4 they used 20 lbs.

B-9 range has tons of 50 cal bullets its all covered up from hills washing out. Thousands of Bazooka rockets with spent rocket motors containing propellant number7. Also this was a tank gun range where I have identified two types of projectiles (37mm) both containing tracer elements as do every fifth 50 cal round, The tracer element is made up of phosphorus on all projectiles. There were also stationary targets at this sight. This sight was used before world war two until the late 1950's.

Deep bottom pond was cut in two around 1980 for a water works div. on maneuvers. There job was water supply, they pumped the water into huge rubber tanks for treatment and storage. The bottom of the pond is about 100 yards to the north. All life in the pond was killed (The biggest bullfrogs we had ever seen were there).

The subject of defoliation covers all the power lines and fire lanes (widened dirt roads and the impact area). The spray trucks I saw were either using the water or washing there trucks.

Donnelly pond was the main staging area for defoliation (orange drums laying around). The water works are had residue all the banks including fireworks, C4, detonators etc. This area should be approached with caution.

CS-19 report is clear but I only saw a tanker truck once in 1969 but there was a large pipe sticking out of the ground in the hole and lots of rusty filter cartridges there besides everything else.

I did not get to show Paul the Valley of death I saw a ramp bulldozed at the top of the hill and plenty of tracks from trucks but never saw trucks there, (they took one way in and one way out) remember I entered the impact area on wood road passing by the valley on my left



turning right to get to my bunker. There have never been bulldozers in the valley and I can prove it.

The impact area has been a dumping area all along and is today (hundreds of chaff canisters, rocket motors, stuff from AVCO, junk). I can prove it, it all gets blown up and sent into the air and water. I wanted to walk turpentine road at the center of tank ally I call ground zero where after a Saturday of artillery practice the ground would be smoking and it stunk. I estimate 200 heavy artillery rounds are fired on a good day. From one of the observation post I would sit and watch the artillery practice. Salvos of five or six rounds would fly over and hit causing a hue cloud of red dust high into the air with a lower dark cloud from the explosion itself (composition B) Floating east sometimes west if it came towards me I usually left. I was on the northwest side of the impact area most of the time.

Demo area 3 is the truck bomb area I could not show.

The law rocket range is a sight to see. Thousands of rockets lying around.

Areas of smoke grenades rusting. Every year another 1000 get left on the ground. I showed one on the B9 range.

The chemical warfare gas chambers. I've been gassed involuntarily.

We must also discuss the mobil radars two types that I know of, artillery finder phased array and foreword air control.

50 cal heavy machine range where they have shot rounds into Sandwich. I can prove it.

Avco is the last place I would like to visit.

**Mr. Zanis remarks of April 20 are both inclusive and additional to comments previously made. All sites will be cross-referenced with archival information and used in conjunction with data retrieved from soil and water testing to identify additional sites requiring investigation.**

**Deep Bottom pond is an area which will receive testing. 50 cal ammunition is extremely low in lead content is not considered to pose as significant a potential health risk as munitions with higher lead content. Therefore 50 cal. ranges are not initially high on the list of potential source sites. Areas where C4 use and powder bag disposal may have occurred are of great interest to the initial phases of the study.**

**We once again thank Mr. Zanis for his time and information which are essential to the study. (Note that a formal interview with Mr. Zanis to collect information for the Archive Search task was conducted on June 5, 1997).**



Paul Zanis comments dated 28 March 1997  
**(response in bold)**

Here are my areas of concern after reviewing the action plan for camp edwards impact area groundwater study. Why is the rod and gun club included but not the moving target range where soil samples and a test well should be a priority. Deep bottom pond should be studied soil and water. Soil sampling should be taken between goat pasture road and the five corners known by the locals as the valley of death. Soil samples should be taken at the corner tank alley and turpentine road. Soil samples should also be taken between cs 19 and tank alley. The ancient well by suconsette pond should be of interest. How can soil samples of demo area 1 be taken when its been filled with clean fill. A test well should be drilled between cs19 and suconsette pond. The sediments of opening pond could be sampled. Sonic drill rigs not be used in the impact area. The orange stuff should be identified in the impact area. Phosphorus should be included in the constituent of a bullet because every fifth round is a tracer. Classifications of weapons should be corrected, a .50 cal machine gun is a heavy machine gun by definition. 4.2 inch mortar is a heavy mortar and 155mm and 8 inch caliber artillery is heavy artillery. Since heavy artillery fires comp B and that is what is mostly out there that should be if the utmost concern for the study. Past demo areas 3 and 4 should be identified. The only other area of concern to me is the shock effect from salvos of heavy artillery on the aquifer. Also water and soil samples should be studied buy outside sources to confirm results.

**Mr. Zanis has provided a wealth of local knowledge on several occasions. His letters of March 28, 1997, April 20, 1997, June 21, 1997 and his extensive interview conducted on June 5, 1997 have been used to help guide a portion of the archive search and have provided critical information on previously unknown activities.**

**His letter of March 28, 1997 includes some sites addressed in his June 21, 1997 letter. Deep Bottom Pond will now be sampled as a part of the study. The ground scar depression area is also scheduled for soil sampling and will now be scheduled for groundwater testing. A revision of the well location plan and soil sampling protocol, due out in the final Action Plan, has considered initial data collection. This plan will characterize the soil and groundwater throughout the area. Response plans to all data collected during the archive search and interview period will further refine the locations of potential areas of concern.**



## **APPENDIX-C**

Standard Operating Procedures



## Appendix C.1

### MMR Hand Auger Sampling Protocol

**Objectives:** Evaluate maximum concentrations of contaminants at each location, and the spatial variability of these concentrations.

**Soil Boring Grids:** Each grid will consist of nine sample points spaced ten feet apart. The grid locations have been marked for UXO avoidance. All magnetic anomalies are flagged and will be avoided. Grid positions are shown in the figure that is included in each Field Sampling Plan attachment to the Action Plan.

**Protocol:** The following protocol summarizes MMR SOPs (Section 4.2 of the Action Plan), the Ogden Health and Safety Guidelines, and the EPA Standard Guide for Composite Sampling and Field Subsampling for Environmental Waste Management Activities, dated October 31, 1996.

#### Shallow Sample (0-6")

- A 0-6" soil sample will be collected from each of nine sample points in the grid;
- soil from each sample point will be placed in a headspace jar;
- the remaining soil from each of the nine sample points will be composited in accordance with Section 8.1 of the EPA Standard Guide;
- headspace measurements will be collected from each of the nine 0-6" samples and recorded on the hand auger log in the space provided;
- a VOC grab sample will be collected from one sample point based on the following priority of observations: 1) highest response on the FID, 2) visual signs of contamination, or 3) the central grid location (a fresh soil sample will be collected adjacent to the sample point and placed in a headspace free 4oz jar);
- the composite sample will be submitted for inorganics, explosives (colorimetric/8330), and SVOC, PCB/pest., herbicide, and EDB/MTBE analysis.

#### Deep Sample (18-24")

- An 18-24" VOC grab sample will be submitted from the same sample point which was selected for VOC sampling in the shallow depth interval;
- soil from the deep interval from each sample point within the grid will be composited and submitted for explosives (colorimetric/8330), inorganics, and SVOC, PCB/pest., herbicide, and EDB/MTBE analysis;

#### Contingencies

- The deep samples collected for SVOC, PCB/pest., and herbicide analysis will be submitted to the laboratory 'ON HOLD' awaiting results from the shallow sample. The criteria for deciding whether to analyze deep samples for these analytes will be detectable levels in the shallow sample.
- All composite samples from the Impact Area with detectable levels of explosives by the colorimetric method will be analyzed by EPA Method 8330. These samples will be chosen by the laboratory based on the results of the samples analyzed by the colorimetric method.

#### Example:

0 - 6"    Explosives - composite, colorimetric (100% detects get 8330 in Impact Area, 10% overall)

    Inorganics - composite

    Other Analytes - composite

    VOC - grab, from the sample point with the highest FID hit

18 - 24" Explosives - composite, colorimetric (100% detects get 8330 in Impact Area, 10% overall)

    Inorganics - composite

    Other Analytes - composite, ON HOLD (analyze for group(s) of analytes detected in 0-6")

    VOC - grab, from same sample point as the 0-6" VOC



## Appendix C.2

### MMR Soil Boring Installation/Groundwater Profiling Protocol

**Objectives:** Lithologic logging, field screening using an FID, laboratory analysis of explosives, inorganics and target analytes including VOC, SVOC, PCB/pest., herbicide, and EDB/MTBE.

**Soil Boring Locations:** All boring locations within the Impact Area and Buffer Zone will be advanced using a Barber rig after UXO avoidance to a depth of 12 feet or until native soil is encountered. The UXO avoidance will be performed with an auger. Borings outside the Buffer Zone will be advanced with a Rotosonic rig without UXO avoidance. There are three general protocols for soil and groundwater sampling depending on the location of the boring, the drilling method, and the analyses required.

Drilling locations with one well proposed will be advanced to the water table or to a depth based on lithology and field screening at nearby borings in consultation with EPA. At locations with a cluster proposed, soil and groundwater samples will be collected from the deep boring which will be advanced to bedrock. The water table well and bedrock well will be constructed in the deep boring. Clusters that have an intermediate well proposed will have a second boring advanced adjacent to the first boring, without any soil or groundwater collection.

**General Protocol:** This protocol summarizes MMR SOPs (Section 4.2 of the Action Plan), the Ogden Health and Safety Guidelines, and the method outlined in the EPA Standard Guide for Composite Sampling and Field Subsampling for Environmental Waste Management Activities, dated October 31, 1996.

#### **Sampling Protocol 1:**

**UXO Clearance at Drilling Locations:** All locations in the Impact Area and Buffer Zone will be intrusively cleared to two feet below grade ahead of time. Prior to drilling with the Barber rig the UXO team will clear each location to twelve feet below grade using an auger rig.

- from two feet to ten feet below grade, a down hole magnetometer will be lowered into the hole prior to advancing the auger in two foot intervals (at every two foot interval the auger will be removed, 4" PCV will be inserted in the borehole and the rig will be moved off of the hole if needed to prevent impacting the magnetometer prior to the magnetic survey);
- The boring location will be considered clear when a boring depth of ten feet is reached (magnetic depth of 12 feet) without encountering any magnetic anomalies.
- In the event of magnetic anomalies the borehole will be relocated and clearance operations started over at two feet.

#### **Sampling Protocol 2:**

**MW1, MW2, MW7, MW8, MW16, MW19, MW3, MW4, MW5, MW6, MW9, MW25, MW26, MW27**  
These are Barber Rig locations because they are either in the Impact Zone, Demo Areas or the Buffer Zone.

#### In the Unsaturated Zone:

- A 0-6" grab sample will be collected and submitted for explosives, inorganics, and other analytes;
- An 18-24" grab sample will be collected and submitted for explosives, inorganics, and other analytes, (the other analytes will be submitted ON HOLD and analyzed only for analyte groups detected in the 0-6" sample);
- explosives detected in samples analyzed by the colorimetric method will be analyzed by 8330;
- from 10 feet below grade until the water table is encountered, a soil sample will be collected every ten feet using a split spoon;
- the 10-12' interval will be FID screened and submitted for explosives, inorganics and other analytes;



- the 20-22' interval will be FID screened and submitted for explosives and inorganics;
- any samples from these two intervals with explosives detected will be analyzed by 8330;
- each sample below the 20-22' interval will be screened with an FID and sampled for explosives and inorganics analysis and submitted ON HOLD;
- each sample below the 20-22' interval will be sampled for other analytes only if there is a response on the FID;
- the soil samples submitted ON HOLD will be analyzed only if explosives are detected in the 10-12' or 20-22' sample intervals.

In the Saturated Zone:

- from the water table to bedrock a groundwater sample will be collected every ten feet and submitted for explosives and VOC analysis.

**Sampling Protocol 3:**

**MW10, MW17, MW18, MW20, MW21, MW22, MW23, MW24, MW30** These are Rotosonic Rig locations because they are outside the Buffer Zone.

In the Unsaturated Zone:

- from ground surface to the water table, ten foot samples will be collected continuously;
- each sample will be screened with an FID;
- all samples registering a response on the FID will be evaluated for analysis for explosives, inorganics and other analytes.

In the Saturated Zone:

- from the top of the water table to bedrock a groundwater sample will be collected every ten feet and submitted for explosives and VOC analysis.



## Appendix C.3

### MMR Surface Water/Sediment/Storm Water Sampling Protocol

**Objectives:** Natural depressions will be investigated as probable conduits and areas of compound accumulation resulting from storm water runoff, subwatershed, or groundwater interception.

**Visual Inspection:** Sample position(s) within each subwatershed, pond, and swamp will be located where surface water enters the low area, as shown in the Field Sampling Plan for these areas.

**Protocol:** The following protocol summarizes MMR SOPs , the Ogden Health and Safety Guidelines, and the EPA Standard Guide for Composite Sampling and Field Subsampling for Environmental Waste Management Activities, dated October 31, 1996..

#### Protocol for Storm Water and Surface Water Sampling:

- At ponds and swamps the surface water will be collected prior to sediment sampling;
- the geologist will enter the water downstream from the sample point and only if necessary;
- the sample will be collected by submerging the sample containers - containers with preservative will be filled using a decontaminated stainless steel or glass container;
- the sample will be submitted for inorganics, explosives(8330), hardness, and other analytes;

#### Protocol for Sediment Sampling:

- A 0-6" sediment sample will be collected with a decontaminated trowel from the same location(s) as the surface water sample;
- the sediment will be placed in a decontaminated bowl and homogenized (the VOC sample will be taken directly from the trowl prior to homogenization);
- the homogenized sample will be submitted for explosives (8330), inorganics, total organic carbon, and other analytes.

#### Contingencies:

If there is no surface water in the pond/swamp, just the soil/sediment sample will be sampled.



## Appendix C.4

### MMR Groundwater Sampling Protocol

**Objectives:** collection of groundwater for analysis

**Protocol:** The following protocol summarizes MMR SOPs , the Ogden Health and Safety Guidelines, NGB guidelines, and the EPA Low Stress (low flow) Purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells, July 30, 1996.

**Protocol for Groundwater Sampling:**

- The water level will be measured at every well prior to purging;
- the well will be purged according to EPA guidelines GW0001 Low Stress (low flow) Purging and Sampling;
- groundwater will be submitted for inorganics, explosives (8330), and other analytes.



## **APPENDIX-D**

EPA Region I Low Stress (low flow) Purging and Sampling Procedure  
for the Collection of Ground Water Samples from Monitoring Wells



**U.S. ENVIRONMENTAL PROTECTION AGENCY  
REGION I**

**LOW STRESS (low flow) PURGING AND SAMPLING  
PROCEDURE FOR THE COLLECTION OF  
GROUND WATER SAMPLES  
FROM MONITORING  
WELLS**



**July 30, 1996  
Revision 2**



U.S. ENVIRONMENTAL PROTECTION AGENCY  
REGION I

LOW STRESS (low flow) PURGING AND SAMPLING PROCEDURE  
FOR THE COLLECTION OF GROUND WATER SAMPLES  
FROM MONITORING WELLS

I. SCOPE & APPLICATION

This standard operating procedure (SOP) provides a general framework for collecting ground water samples that are indicative of mobile organic and inorganic loads at ambient flow conditions (both the dissolved fraction and the fraction associated with mobile particulates). The SOP emphasizes the need to minimize stress by low water-level drawdowns, and low pumping rates (usually less than 1 liter/min) in order to collect samples with minimal alterations to water chemistry. This SOP is aimed primarily at sampling monitoring wells that can accept a submersible pump and have a screen, or open interval length of 10 feet or less (this is the most common situation). However, this procedure is flexible and can be used in a variety of well construction and ground-water yield situations. Samples thus obtained are suitable for analyses of ground water contaminants (volatile and semi-volatile organic analytes, pesticides, PCBs, metals and other inorganics), or other naturally occurring analytes.

This procedure does not address the collection of samples from wells containing light or dense non-aqueous phase liquids (LNAPLs and DNAPLs). For this the reader may wish to check: Cohen, R.M. and J.W. Mercer, 1993, DNAPL Site Evaluation; C.K. Smoley (CRC Press), Boca Raton, Florida and U.S. Environmental Protection Agency, 1992, RCRA Ground-Water Monitoring: Draft Technical Guidance; Washington, DC (EPA/530-R-93-001).

The screen, or open interval of the monitoring well should be optimally located (both laterally and vertically) to intercept existing contaminant plume(s) or along flowpaths of potential contaminant releases. It is presumed that the analytes of interest move (or potentially move) primarily through the more permeable zones within the screen, or open interval.

Use of trademark names does not imply endorsement by U.S.EPA but is intended only to assist in identification of a specific type of device.



Proper well construction and development cannot be overemphasized, since the use of installation techniques that are appropriate to the hydrogeologic setting often prevents "problem well" situations from occurring. It is also recommended that as part of development or redevelopment the well should be tested to determine the appropriate pumping rate to obtain stabilization of field indicator parameters with minimal drawdown in shortest amount of time. With this information field crews can then conduct purging and sampling in a more expeditious manner.

The mid-point of the saturated screen length (which should not exceed 10 feet) is used by convention as the location of the pump intake. However, significant chemical or permeability contrast(s) within the screen may require additional field work to determine the optimum vertical location(s) for the intake, and appropriate pumping rate(s) for purging and sampling more localized target zone(s). Primary flow zones (high(er) permeability and/or high(er) chemical concentrations) should be identified in wells with screen lengths longer than 10 feet, or in wells with open boreholes in bedrock. Targeting these zones for water sampling will help insure that the low stress procedure will not underestimate contaminant concentrations. The Sampling and Analysis Plan must provide clear instructions on how the pump intake depth(s) will be selected, and reason(s) for the depth(s) selected.

Stabilization of indicator field parameters is used to indicate that conditions are suitable for sampling to begin. Achievement of turbidity levels of less than 5 NTU and stable drawdowns of less than 0.3 feet, while desirable, are not mandatory. Sample collection may still take place provided the remaining criteria in this procedure are met. If after 4 hours of purging indicator field parameters have not stabilized, one of 3 optional courses of action may be taken: a) continue purging until stabilization is achieved, b) discontinue purging, do not collect any samples, and record in log book that stabilization could not be achieved (documentation must describe attempts to achieve stabilization) c) discontinue purging, collect samples and provide full explanation of attempts to achieve stabilization (note: there is a risk that the analytical data obtained, especially metals and strongly hydrophobic organic analytes, may not meet the sampling objectives).

Changes to this SOP should be proposed and discussed when the site Sampling and Analysis Plan is submitted for approval. Subsequent requests for modifications of an approved plan must include adequate technical justification for proposed changes. All changes and modifications must be approved before implementation in field.

## **II. EQUIPMENT**

### **A. Extraction device**

Adjustable rate, submersible pumps are preferred (for example, centrifugal or bladder pump constructed of stainless steel or



Teflon).

Adjustable rate, peristaltic pumps (suction) may be used with caution. Note that EPA guidance states: "Suction pumps are not recommended because they may cause degassing, pH modification, and loss of volatile compounds" (EPA/540/P-87/001, 1987, page 8.5-11).

The use of inertial pumps is discouraged. These devices frequently cause greater disturbance during purging and sampling and are less easily controlled than the pumps listed above. This can lead to sampling results that are adversely affected by purging and sampling operations, and a higher degree of data variability.

#### B. Tubing

Teflon or Teflon lined polyethylene tubing are preferred when sampling is to include VOCs, SVOCs, pesticides, PCBs and inorganics.

PVC, polypropylene or polyethylene tubing may be used when collecting samples for inorganics analyses. However, these materials should be used with caution when sampling for organics. If these materials are used, the equipment blank (which includes the tubing) data must show that these materials do not add contaminants to the sample.

Stainless steel tubing may be used when sampling for VOCs, SVOCs, pesticides, and PCBs. However, it should be used with caution when sampling for metals.

The use of 1/4 inch or 3/8 inch (inner diameter) tubing is preferred. This will help ensure the tubing remains liquid filled when operating at very low pumping rates.

Pharmaceutical grade (Pharmed) tubing should be used for the section around the rotor head of a peristaltic pump, to minimize gaseous diffusion.

C. Water level measuring device(s), capable of measuring to 0.01 foot accuracy (electronic "tape", pressure transducer). Recording pressure transducers, mounted above the pump, are especially helpful in tracking water levels during pumping operations, but their use must include check measurements with a water level "tape" at the start and end of each record.

D. Flow measurement supplies (e.g., graduated cylinder and stopwatch).

E. Interface probe, if needed.

F. Power source (generator, nitrogen tank, etc.). If a gasoline generator is used, it must be located downwind and at least 30 feet from the well so that the exhaust fumes do not contaminate the samples.



G. Indicator field parameter monitoring instruments - pH, Eh, dissolved oxygen (DO), turbidity, specific conductance, and temperature. Use of a flow-through-cell is required when measuring all listed parameters, except turbidity. Standards to perform field calibration of instruments. Analytical methods are listed in 40 CFR 136, 40 CFR 141, and SW-846. For Eh measurements, follow manufacturer's instructions.

H. Decontamination supplies (for example, non-phosphate detergent, distilled/deionized water, isopropyl alcohol, etc.).

I. Logbook(s), and other forms (for example, well purging forms).

J. Sample Bottles.

K. Sample preservation supplies (as required by the analytical methods).

L. Sample tags or labels.

M. Well construction data, location map, field data from last sampling event.

N. Well keys.

O. Site specific Sample and Analysis Plan/Quality Assurance Project Plan.

P. PID or FID instrument (if appropriate) to detect VOCs for health and safety purposes, and provide qualitative field evaluations.

### **III. PRELIMINARY SITE ACTIVITIES**

Check well for security damage or evidence of tampering, record pertinent observations.

Lay out sheet of clean polyethylene for monitoring and sampling equipment.

Remove well cap and immediately measure VOCs at the rim of the well with a PID or FID instrument and record the reading in the field logbook.

If the well casing does not have a reference point (usually a V-cut or indelible mark in the well casing), make one. Describe its location and record the date of the mark in the logbook.

A synoptic water level measurement round should be performed (in the shortest possible time) before any purging and sampling activities begin. It is recommended that water level depth (to 0.01 ft.) and



total well depth (to 0.1 ft.) be measured the day before, in order to allow for re-settlement of any particulates in the water column. If measurement of total well depth is not made the day before, it should not be measured until after sampling of the well is complete. All measurements must be taken from the established referenced point. Care should be taken to minimize water column disturbance.

Check newly constructed wells for the presence of LNAPLs or DNAPLs before the initial sampling round. If none are encountered, subsequent check measurements with an interface probe are usually not needed unless analytical data or field head space information signal a worsening situation. Note: procedures for collection of LNAPL and DNAPL samples are not addressed in this SOP.

#### **IV. PURGING AND SAMPLING PROCEDURE**

Sampling wells in order of increasing chemical concentrations (known or anticipated) is preferred.

##### **1. Install Pump**

Lower pump, safety cable, tubing and electrical lines slowly (to minimize disturbance) into the well to the midpoint of the zone to be sampled. The Sampling and Analysis Plan should specify the sampling depth, or provide criteria for selection of intake depth for each well (see Section I). If possible keep the pump intake at least two feet above the bottom of the well, to minimize mobilization of particulates present in the bottom of the well. Collection of turbid free water samples may be especially difficult if there is two feet or less of standing water in the well.

##### **2. Measure Water Level**

Before starting pump, measure water level. If recording pressure transducer is used-initialize starting condition.

##### **3. Purge Well**

###### **3a. Initial Low Stress Sampling Event**

Start the pump at its lowest speed setting and slowly increase the speed until discharge occurs. Check water level. Adjust pump speed until there is little or no water level drawdown (less than 0.3 feet). If the minimal drawdown that can be achieved exceeds 0.3 feet but remains stable, continue purging until indicator field parameters stabilize.

Monitor and record water level and pumping rate every three to five minutes (or as appropriate) during purging. Record any pumping rate adjustments (both time and flow rate). Pumping rates should, as needed, be reduced to the minimum capabilities of the pump (for example, 0.1 - 0.4 l/min) to ensure stabilization of indicator



parameters. Adjustments are best made in the first fifteen minutes of pumping in order to help minimize purging time. During pump start-up, drawdown may exceed the 0.3 feet target and then "recover" as pump flow adjustments are made. Purge volume calculations should utilize stabilized drawdown value, not the initial drawdown. Do not allow the water level to fall to the intake level (if the static water level is above the well screen, avoid lowering the water level into the screen). The final purge volume must be greater than the stabilized drawdown volume plus the extraction tubing volume.

Wells with low recharge rates may require the use of special pumps capable of attaining very low pumping rates (bladder, peristaltic), and/or the use of dedicated equipment. If the recharge rate of the well is lower than extraction rate capabilities of currently manufactured pumps and the well is essentially dewatered during purging, then the well should be sampled as soon as the water level has recovered sufficiently to collect the appropriate volume needed for all anticipated samples (ideally the intake should not be moved during this recovery period). Samples may then be collected even though the indicator field parameters have not stabilized.

### 3b. Subsequent Low Stress Sampling Events

After synoptic water level measurement round, check intake depth and drawdown information from previous sampling event(s) for each well. Duplicate, to the extent practicable, the intake depth and extraction rate (use final pump dial setting information) from previous event(s). Perform purging operations as above.

### 4. Monitor Indicator Field Parameters

During well purging, monitor indicator field parameters (turbidity, temperature, specific conductance, pH, Eh, DO) every three to five minutes (or less frequently, if appropriate). Note: during the early phase of purging emphasis should be put on minimizing and stabilizing pumping stress, and recording those adjustments. Purging is considered complete and sampling may begin when all the above indicator field parameters have stabilized. Stabilization is considered to be achieved when three consecutive readings, taken at three (3) to five (5) minute intervals, are within the following limits:

turbidity (10% for values greater than 1 NTU),  
DO (10%),  
specific conductance (3%),  
temperature (3%),  
pH ( $\pm$  0.1 unit),  
ORP/Eh ( $\pm$  10 millivolts).

All measurements, except turbidity, must be obtained using a flow-through-cell. Transparent flow-through-cells are preferred, because they allow field personnel to watch for particulate build-up within the cell. This build-up may affect indicator field parameter values



measured within the cell and may also cause an underestimation of turbidity values measured after the cell. If the cell needs to be cleaned during purging operations, continue pumping and disconnect cell for cleaning, then reconnect after cleaning and continue monitoring activities.

The flow-through-cell must be designed in a way that prevents air bubble entrapment in the cell. When the pump is turned off or cycling on/off (when using a bladder pump), water in the cell must not drain out. Monitoring probes must be submerged in water at all times. If two flow-through-cells are used in series, the one containing the dissolved oxygen probe should come first (this parameter is most susceptible to error if air leaks into the system).

## 5. Collect Water Samples

Water samples for laboratory analyses must be collected before water has passed through the flow-through-cell (use a by-pass assembly or disconnect cell to obtain sample).

VOC samples should be collected first and directly into pre-preserved sample containers. Fill all sample containers by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

During purging and sampling, the tubing should remain filled with water so as to minimize possible changes in water chemistry upon contact with the atmosphere. It is recommended that 1/4 inch or 3/8 inch (inside diameter) tubing be used to help insure that the sample tubing remains water filled. If the pump tubing is not completely filled to the sampling point, use one of the following procedures to collect samples: (1) add clamp, connector (Teflon or stainless steel) or valve to constrict sampling end of tubing; (2) insert small diameter Teflon tubing into water filled portion of pump tubing allowing the end to protrude beyond the end of the pump tubing, collect sample from small diameter tubing; (3) collect non-VOC samples first, then increase flow rate slightly until the water completely fills the tubing, collect sample and record new drawdown, flow rate and new indicator field parameter values.

Add preservative, as required by analytical methods, to samples immediately after they are collected if the sample containers are not pre-preserved. Check analytical methods (e.g. EPA SW-846, water supply, etc.) for additional information on preservation. Check pH for all samples requiring pH adjustment to assure proper pH value. For VOC samples, this will require that a test sample be collected during purging to determine the amount of preservative that needs to be added to the sample containers prior to sampling.

If determination of filtered metal concentrations is a sampling objective, collect filtered water samples using the same low flow procedures. The use of an in-line filter is required, and the filter



size (0.45 um is commonly used) should be based on the sampling objective. Pre-rinse the filter with approximately 25 - 50 ml of ground water prior to sample collection. Preserve filtered water sample immediately. Note: filtered water samples are not an acceptable substitute for unfiltered samples when the monitoring objective is to obtain chemical concentrations of total mobile contaminants in ground water for human health risk calculations.

Label each sample as collected. Samples requiring cooling (volatile organics, cyanide, etc.) will be placed into a cooler with ice or refrigerant for delivery to the laboratory. Metal samples after acidification to a pH less than 2 do not need to be cooled.

#### 6. Post Sampling Activities

If recording pressure transducer is used, remeasure water level with tape.

After collection of the samples, the pump tubing may either be dedicated to the well for resampling (by hanging the tubing inside the well), decontaminated, or properly discarded.

Before securing the well, measure and record the well depth (to 0.1 ft.), if not measured the day before purging began. Note: measurement of total well depth is optional after the initial low stress sampling event. However, it is recommended if the well has a "silting" problem or if confirmation of well identity is needed.

Secure the well.

#### V. DECONTAMINATION

Decontaminate sampling equipment prior to use in the first well and following sampling of each subsequent well. Pumps will not be removed between purging and sampling operations. The pump and tubing (including support cable and electrical wires which are in contact with the well) will be decontaminated by one of the procedures listed below.

##### Procedure 1

The decontaminating solutions can be pumped from either buckets or short PVC casing sections through the pump or the pump can be disassembled and flushed with the decontaminating solutions. It is recommended that detergent and isopropyl alcohol be used sparingly in the decontamination process and water flushing steps be extended to ensure that any sediment trapped in the pump is removed. The pump exterior and electrical wires must be rinsed with the decontaminating solutions, as well. The procedure is as follows:

Flush the equipment/pump with potable water.



Flush with non-phosphate detergent solution. If the solution is recycled, the solution must be changed periodically.

Flush with potable or distilled/deionized water to remove all of the detergent solution. If the water is recycled, the water must be changed periodically.

Flush with isopropyl alcohol (pesticide grade). If equipment blank data from the previous sampling event show that the level of contaminants is insignificant, then this step may be skipped.

Flush with distilled/deionized water. The final water rinse must not be recycled.

#### Procedure 2

Steam clean the outside of the submersible pump.

Pump hot potable water from the steam cleaner through the inside of the pump. This can be accomplished by placing the pump inside a three or four inch diameter PVC pipe with end cap. Hot water from the steam cleaner jet will be directed inside the PVC pipe and the pump exterior will be cleaned. The hot water from the steam cleaner will then be pumped from the PVC pipe through the pump and collected into another container. Note: additives or solutions should not be added to the steam cleaner.

Pump non-phosphate detergent solution through the inside of the pump. If the solution is recycled, the solution must be changed periodically.

Pump potable water through the inside of the pump to remove all of the detergent solution. If the solution is recycled, the solution must be changed periodically.

Pump distilled/deionized water through the pump. The final water rinse must not be recycled.

#### **VI. FIELD QUALITY CONTROL**

Quality control samples are required to verify that the sample collection and handling process has not compromised the quality of the ground water samples. All field quality control samples must be prepared the same as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples shall be collected for each batch of samples (a batch may not exceed 20 samples). Trip blanks are required for the VOC samples at a frequency of one set per VOC sample cooler.

Field duplicate.

Matrix spike.



Matrix spike duplicate.

Equipment blank.

Trip blank (VOCs).

Temperature blank (one per sample cooler).

Equipment blank shall include the pump and the pump's tubing. If tubing is dedicated to the well, the equipment blank will only include the pump in subsequent sampling rounds.

Collect samples in order from wells with lowest contaminant concentration to highest concentration. Collect equipment blanks after sampling from contaminated wells and not after background wells.

Field duplicates are collected to determine precision of sampling procedure. For this procedure, collect duplicate for each analyte group in consecutive order (VOC original, VOC duplicate, SVOC original, SVOC duplicate, etc.).

If split samples are to be collected, collect split for each analyte group in consecutive order (VOC original, VOC split, etc.). Split sample should be as identical as possible to original sample.

All monitoring instrumentation shall be operated in accordance with EPA analytical methods and manufacturer's operating instructions. EPA analytical methods are listed in 40 CFR 136, 40 CFR 141, and SW-846 with exception of Eh, for which the manufacturer's instructions are to be followed. Instruments shall be calibrated at the beginning of each day. If a measurement falls outside the calibration range, the instrument should be re-calibrated so that all measurements fall within the calibration range. At the end of each day, check calibration to verify that instruments remained in calibration. Temperature measuring equipment, thermometers and thermistors, need not be calibrated to the above frequency. They should be checked for accuracy prior to field use according to EPA Methods and the manufacturer's instructions.

## VII. FIELD LOGBOOK

A field log shall be kept to document all ground water field monitoring activities (see attached example matrix), and record all of the following:

Well identification.

Well depth, and measurement technique.

Static water level depth, date, time and measurement technique.

Presence and thickness of immiscible liquid (NAPL) layers and



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detection method.

Pumping rate, drawdown, indicator parameters values, and clock time, at the appropriate time intervals; calculated or measured total volume pumped.

Well sampling sequence and time of each sample collection.

Types of sample bottles used and sample identification numbers.

Preservatives used.

Parameters requested for analysis.

Field observations during sampling event.

Name of sample collector(s).

Weather conditions.

QA/QC data for field instruments.

Any problems encountered should be highlighted.

Description of all sampling equipment used, including trade names, model number, diameters, material composition, etc.

## **VIII. DATA REPORT**

Data reports are to include laboratory analytical results, QA/QC information, and whatever field logbook information is needed to allow for a full evaluation of data useability.



## **EXAMPLE (Minimum Requirements)**

## **Well PURGING-FIELD WATER QUALITY MEASUREMENTS FORM**

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Location (site/facility name) \_\_\_\_\_  
Well Number \_\_\_\_\_ Date \_\_\_\_\_  
Field Personnel \_\_\_\_\_  
Sampling Organization \_\_\_\_\_  
Identify MP \_\_\_\_\_

me) Date \_\_\_\_\_

Depth to  
(below MP)      top / bot  
Pump Intake at (ft. below  
Purging Device; (pump typ

Depth to  
(below MP)      top / bottom of screen  
Pump Intake at (ft. below MP)  
Purging Device; (pump type) \_\_\_\_\_

1. Pump dial setting (for example: hertz cycles/min, etc).
2.  $\mu$ Siemens per cm (same as  $\mu$ hos/cm) at 25°C.
3. Oxidation reduction potential (stand in for Eh).





